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SEPTEMBER 1961

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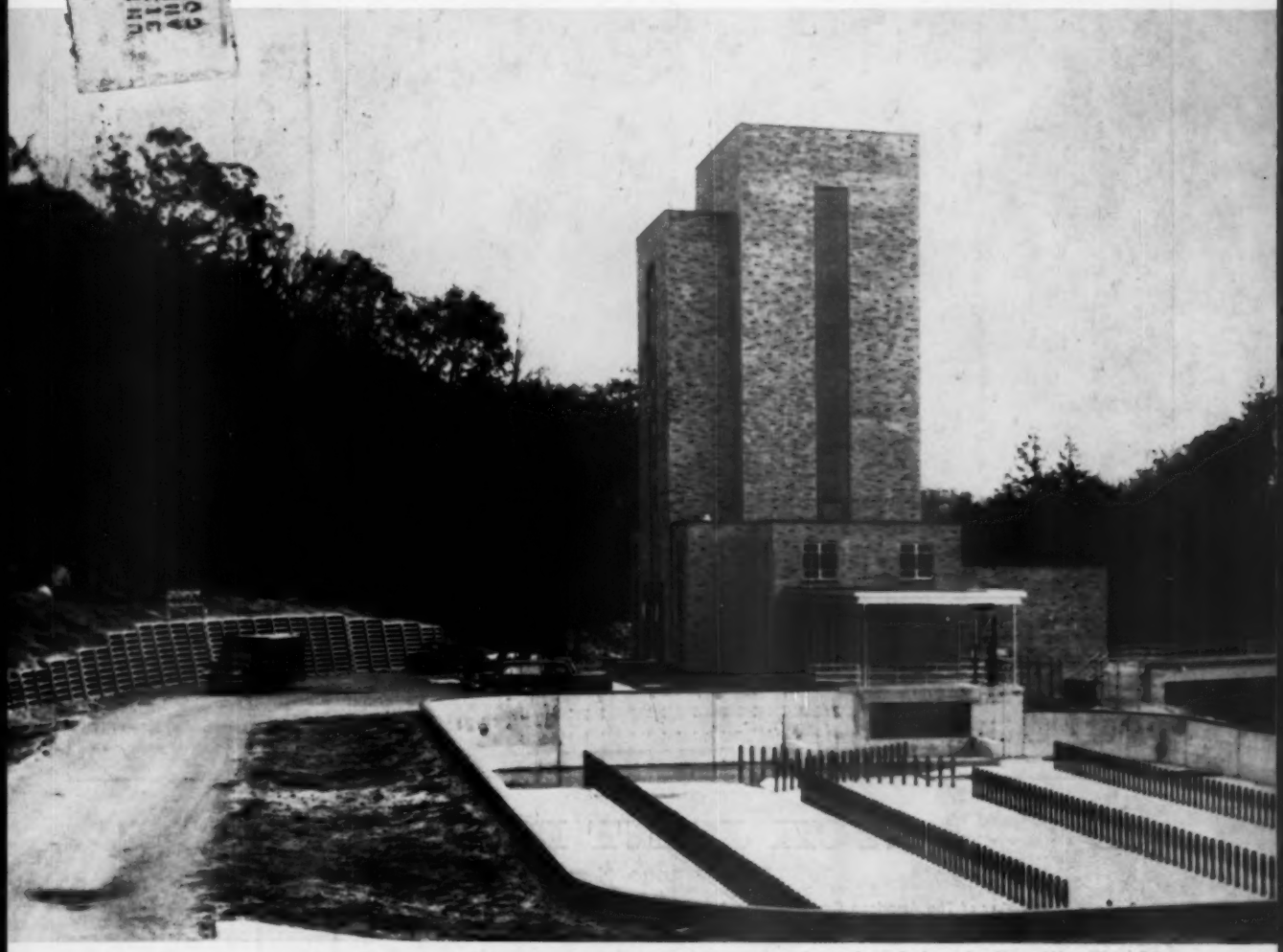
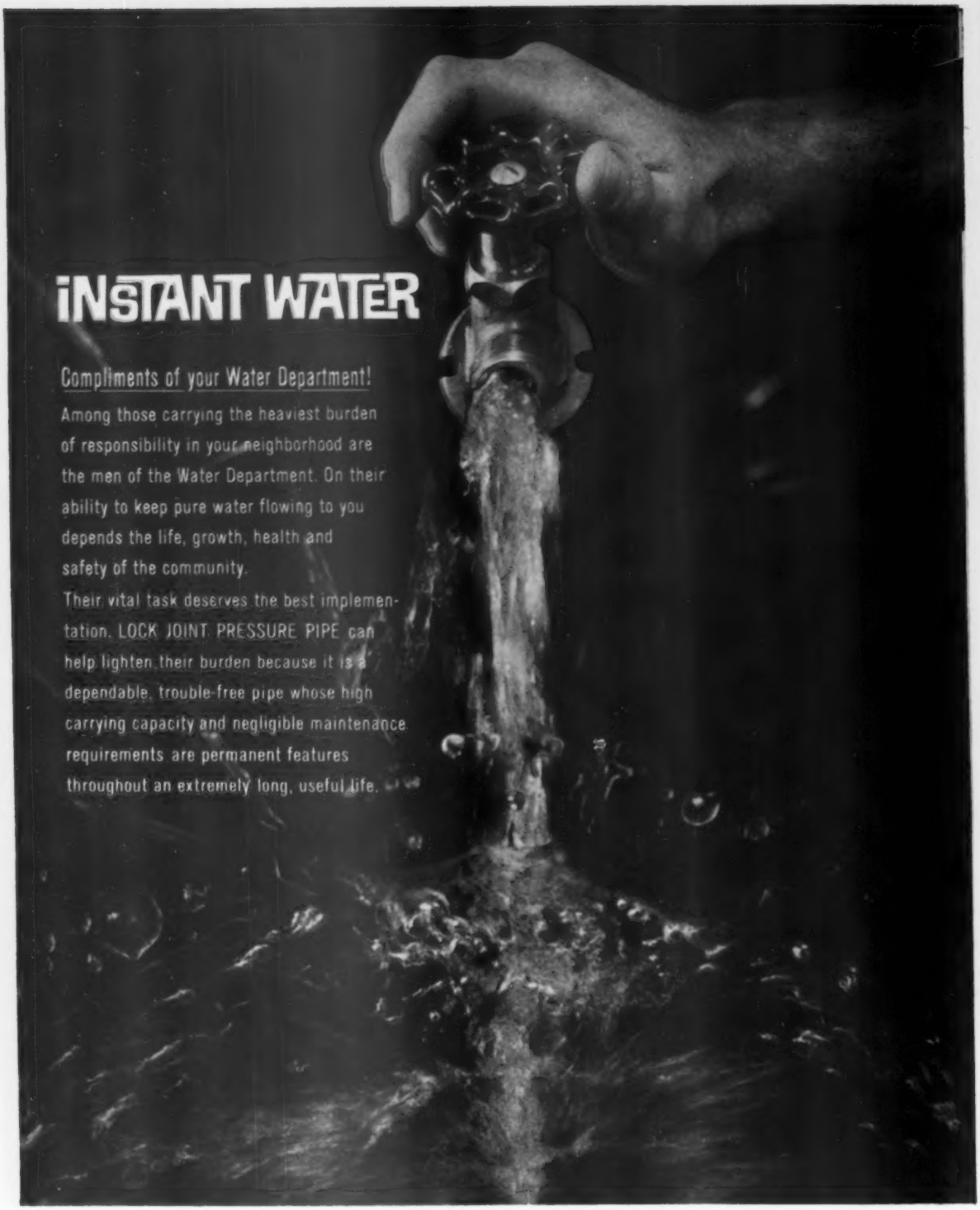


Chemical Treatment Station—Charlotteburg Reservoir Project, N. J. - - - p. 5A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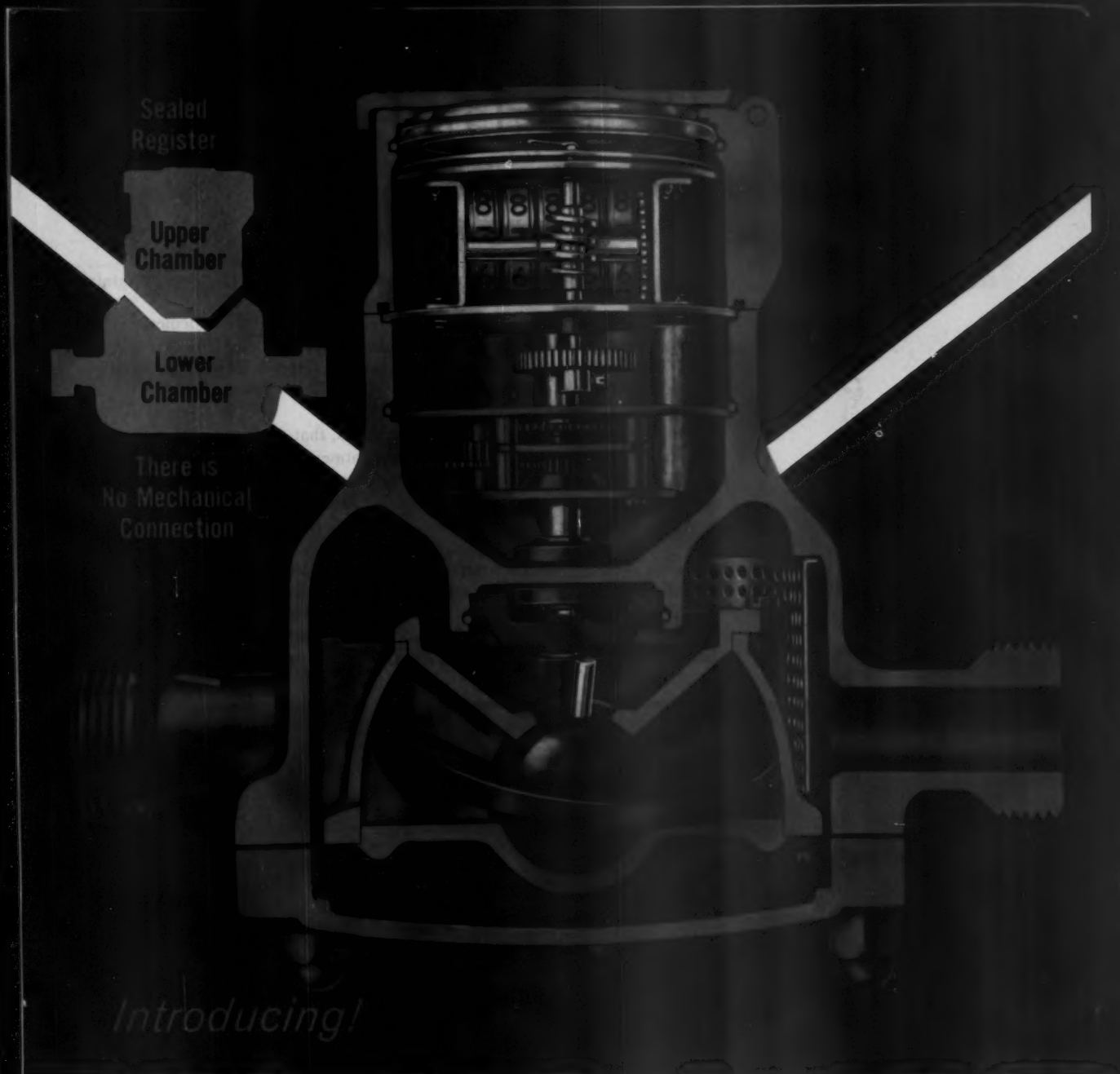

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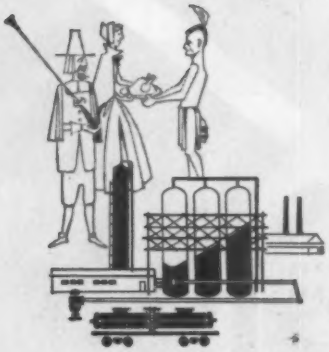

Pilgrims, Progress and P.F.T. mold the colorful history of Hopewell, Virginia.

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WATER & SEWAGE WORKS

VOL. 108 NO. 9

SEPTEMBER 1961

A Scranton Gillette Publication

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E. S. Gillette, Publisher
H. J. Conway, Adv. Ed.
V. W. Langworthy, Editor
C. Terrazas, Asst. Editor
E. E. Halmos, Jr., Construction Editor
W. W. Hamilton, Western Sales Mgr.
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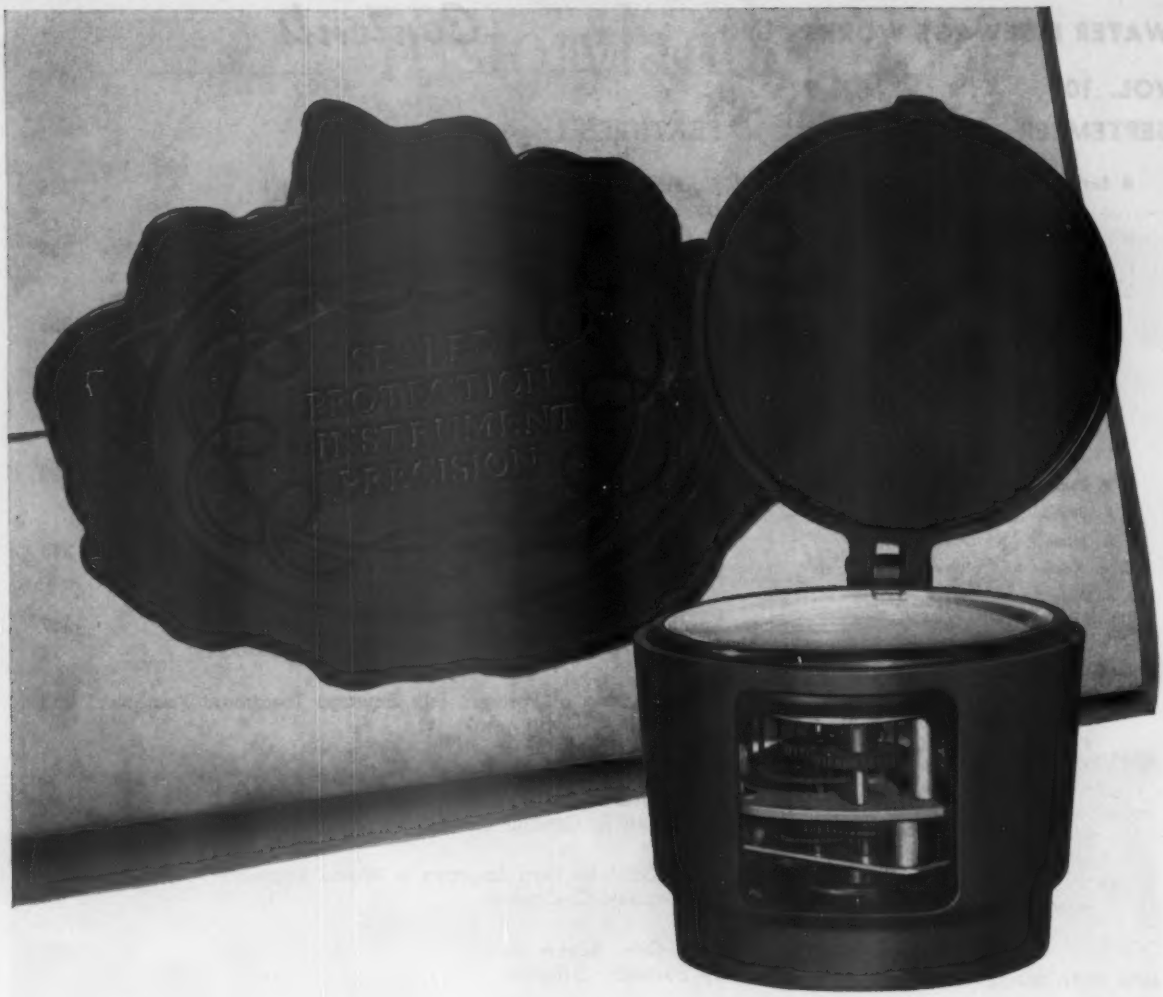

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News—Here & There

New Dam in New Jersey

N. J. AWWA Section members spent June 27 inspecting Newark's new Charlotteburg Reservoir, Dam, and Chemical Treatment Station and playing golf at the North Jersey Country Club. Information for this report is based on data supplied by H. L. Kaufman, Associate, Parsons, Brinckerhoff, Quade & Douglas.

The Charlotteburg Reservoir Project, which is now about 90 percent complete, will provide important benefits to the water supply system of the city. It will increase by 9.5 MGD the supply available to Newark's high level zone which can be supplied by gravity from no other source. It will also improve the quality of the water by correcting the present corrosive characteristic through the addition of lime and soda ash, and with delivery of water from that point to the head of the existing aqueduct at Macopin channel flow which now exists for considerable distance upstream of the Macopin intake.

The works planned and under construction to increase the quantity of the supply are:

a. The Charlotteburg Reservoir with 2.9 billion gallons capacity which involves a massive concrete gravity dam, relocation of a portion of the Wharton and Northern Railroad and of unpaved vehicular road, and a river wall paralleling the New York, Susquehanna & Western Railroad near the upper end of the reservoir,

b. The Farber Brook Diversion Works which will divert runoff from 3.1 square miles of the Farber Brook drainage area from Oak Ridge Reservoir to Canistear Reservoir. This part of the work involves a low diversion dam and a long paved channel.

Works provided to improve the quality of the entire Pequannock River supply are:

a. The extension of the existing Pequannock Aqueduct with reinforced concrete pipe from its present terminus at the Macopin Intake Dam to the intake of the new Charlotteburg Dam.

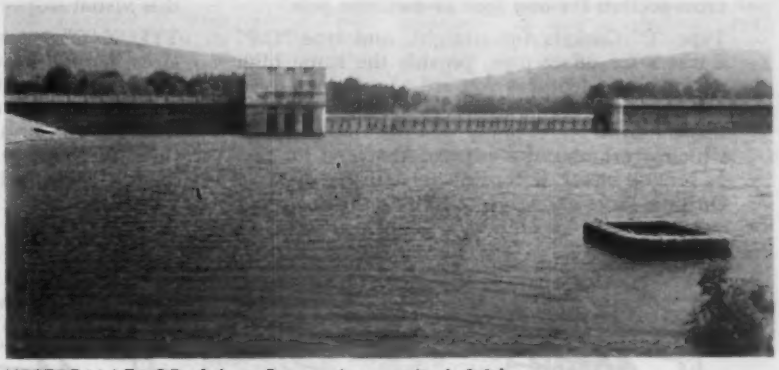
b. Modern treatment works located along the extension of the aquaduct including a screen chamber housing traveling screens, an aerator, and a new chemical building with facilities for receiving, storing and introducing lime, soda ash, chlorine, ammonia and sodium silicofluoride,

c. Works to divert water drawn from Echo Lake to the Charlotteburg Reservoir. Echo Lake water is frequently of poorer quality than water obtained from the remainder of the watershed. It is being blended with the rest of the supply and its quality will be improved by natural purification processes during the additional storage in the Charlotteburg Reservoir.

COVER PHOTO

Chemical building and aeration equipment located downstream of Newark, N. J.'s Charlotteburg Reservoir.

DOWNSTREAM FACE of dam. Spillway is topped with hydraulically operated Bascule gates.



UPSTREAM FACE of dam. Reservoir capacity is 2.9 bg.

Automatic River Monitoring In Penn.

The first automatic river monitoring station in Pennsylvania operated by the State Health Department was placed in operation at Williamsport, July 18, 1961.

The station is designed to give a continuous "picture" at all times of the condition of the Susquehanna River in the Williamsport area. It is located on the Maynard St. Bridge.

Dr. C. L. Wilbar, Jr., state health secretary and sanitary water board chairman, said that the West Branch of the Susquehanna is subject to relatively high concentration of acidity at times of large runoffs due to heavy rains in upstream area of mining operations. Such runoffs, he said, have resulted in fish kills in the past.

The monitoring station is expected to give advance warning of rising acidity, and allow the state engineers to study problems associated with these fish kills.

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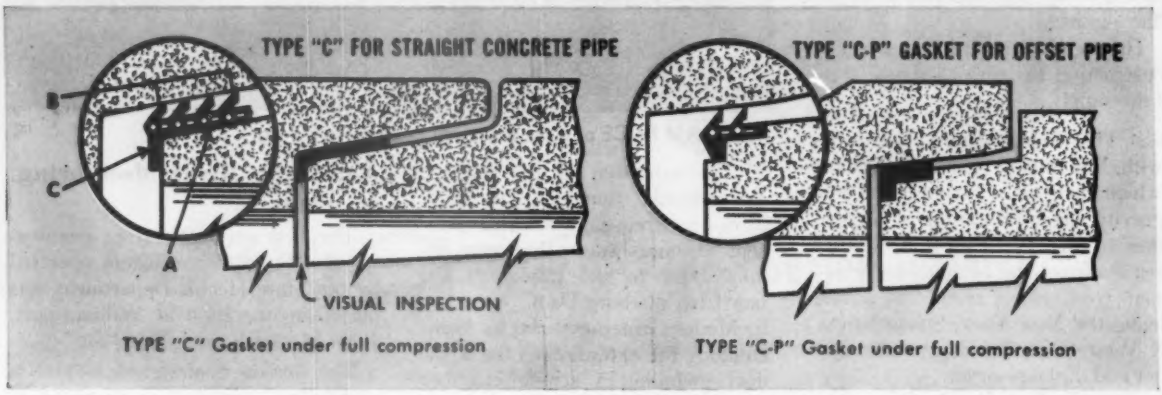

"C" Series TYLOX Gaskets consist of base A; sealing fins B; and inspection flange C. In addition to providing the inspection feature, the "locking" effect of the flange holds Gasket in true position as pipe is coupled. Design of the sealing fins is such that horizontal end-thrust forces causing "kickback" in some couplings, are eliminated in Tylox "C" Series Gaskets, assuring full seating and true alignment of pipe.

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News—Here & There

CONTINUED FROM PAGE 5A

Reader Response

Sir:

Your editorial, "Palatable From Place to Place", serves as a timely reminder that contemporary water works technology and performance standards need continuous and careful scrutiny if more uniformity in potable water quality characteristics is to be attained and maintained. It is largely beyond the writer's current expectations, however, that minor variations in taste and odor characteristics of potable water supplies are of paramount importance or will be substantially minimized in the forseeable future. Nevertheless, apparent advantages of unconventional products (e.g., the absence of iodamine formation and various iodine taste and odor complexes under certain conditions) should be thoroughly investigated and exploited to the fullest extent practicable.

Your points concerning the effectiveness, applications and limitations of conventional potable water disinfectants are well taken. Although waterborne amebiasis has all but vanished in this country, it is certainly indisputable that contamination of a potable water distribution system—as occurred at South Bend, Indiana, in 1953—is always a possibility. It is, of course, well known that amebic cysts are not vulnerable to chlorine in concentrations normally applied, and at residual levels normally maintained, by domestic water utilities. It is similarly known that certain forms of iodine possess rather remarkable cysticidal capacity. But it should be stated that municipal water supplies are not likely to be involved in water-borne amebiasis outbreaks unless there exists local contamination in the distribution system. Under such conditions can it now be said what kind, how much and for how long various residual iodine forms would be required to check a disease outbreak? If so, are such conditions practically and economically attainable? Or, indeed, are they otherwise desirable? Questions such as these, and many others, must be answered before waterworks utility and health officials can be in a position to judge whether a substitution of disinfectant is necessary or warranted.

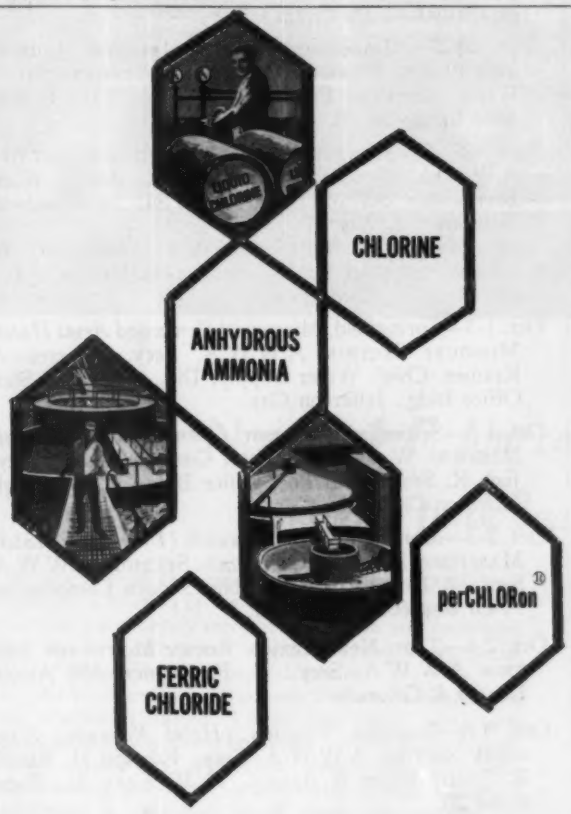
It is a recognized fact that diatomic iodine and hypoiodus acid, as well as hypochlorous acid, are viricidal. But the relative merits of these various disinfectant forms against the causative virus of infectious hepatitis and other enteric viruses are similarly obscure at the present time.

Most of the reports in the literature pertaining to the efficacy of iodine as a disinfectant refer to emergency or other relatively low-volume applications. Until quite recently little information was available on the use of iodine as a disinfectant under conditions paralleling swimming pool chlorination; practically no comparative data are yet available concerning potable water applications.

As pointed out in Dr. Black's paper on swimming pool disinfection with iodine, reports on the kinetics of iodine disinfection, and the bactericidal, cysticidal and viricidal effects of the various iodine forms, are ofttimes incomplete, misleading or inconsistent with other observations. Thus, while there can be absolutely no dispute that iodine posseses significant disinfecting properties under certain operating conditions, it remains to be established precisely what these conditions are, and if, in fact, they are consistent with other potable water treatment objectives or criteria. In addition, it remains to be established that application of iodine as a potable water disinfectant on a large scale is economically sound; and, it must be demonstrated that concentrations required to insure destruction or attenuation of pathogens will impart no acute or cumulative physiologically-harmful effects on the water consumers.

Until such research information is obtained, and overall advantages and disadvantages of one disinfecting agent with respect to another are carefully weighed, the use of iodine and other "new" products, or combinations thereof, must necessarily be limited to those applications and to those conditions for which efficacy and safety have been clearly demonstrated.

Yours very truly,
Edmund J. Laubusch
The Chlorine Institute, Inc.



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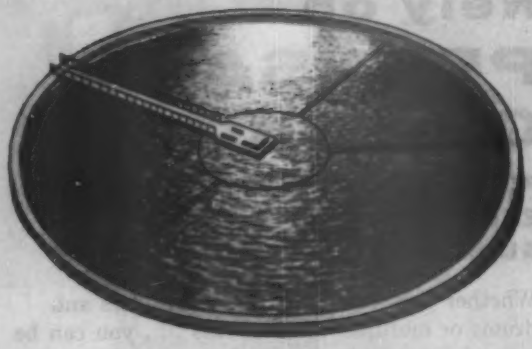

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Sept. 17-21—Poland Spring, Maine. Annual Convention NEW ENGLAND WATER WORKS ASSOCIATION.

Sept. 18-22—Neosho, Missouri (Water & Sewerage Technical School) Short Course: Water Works No. 1. Write: Lloyd Caughran, Director, Water & Sewerage Technical School, Box 348, Neosho, Mo.

Sept. 20-22—Atlanta, Ga. (Ga. Institute of Technology) GA. WATER & SEWAGE ASSN. Secy., Robert S. Ingols, Prof. of Applied Biology, Ga. Institute of Technology.

Sept. 20-22—Rapid City, South Dakota (*Sheraton-Johnson Hotel*) JOINT MEETING SO. DAK. WATER & SEWAGE WORKS CONF., SO. DAK. SECTION A.W.W.A. and SO. DAK. WATER POLLUTION CONTROL ASSN. Secy., Don C. Kalda, So. Dak. Water and Sewage Works Conf., Div. of San Engrg., State Board of Health, Pierre, So. Dak.

Sept. 24-27—Lake Placid, N. Y. AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

Sept. 24-27—Minneapolis, Minn. (*Municipal Auditorium*) PUBLIC WORKS CONGRESS & EQUIPMENT SHOW. Write: American Public Works Assn., 1313 E. 60th St., Chicago 37, Ill.

Sept. 27-29—Milwaukee, Wis. WISCONSIN SECTION A.W.W.A. Fortieth Annual Conf. Secy., Harry Breimeister, 507 Municipal Bldg., 841 N. Broadway, Milwaukee 2, Wis.

Sept. 28—CONNECTICUT A.W.W.A. Secy., D. W. Loiselle, Supt. of Supply, Bridgeport Hydraulic Co., 835 Main St., Bridgeport.

Oct. 1-3—Springfield, Missouri (*Kentwood Arms Hotel*) MISSOURI SECTION A.W.W.A. Secy., Warren A. Kramer, Chief, Water Supply, Div. of Health, State Office Bldg., Jefferson City.

Oct. 1-3—Springfield, Missouri (*Kentwood Arms Hotel*) MISSOURI WATER POLLUTION CONTROL ASSN. Secy., Jack K. Smith, Old Post Office Bldg., 112 W. High, Jefferson City, Mo.

Oct. 2-3—Moncton, New Brunswick (*Brunswick Hotel*) MARITIME BRANCH, CANADIAN SECTION A.W.W.A. Secy., J. Douglas Kline, Public Service Commission, P. O. Box 608, Halifax, N. S.

Oct. 2-4—Taos, New Mexico. ROCKY MOUNTAIN SECTION A.W.W.A. Secy., H. F. Kepner, 550 Alcott, Denver 4, Colorado.

Oct. 4-6—Roanoke, Virginia (*Hotel Roanoke*) VIRGINIA SECTION A.W.W.A. Secy., Edward H. Ruehl, R. Stuart Royer & Assocs., 15 W. Cary St., Richmond 20.

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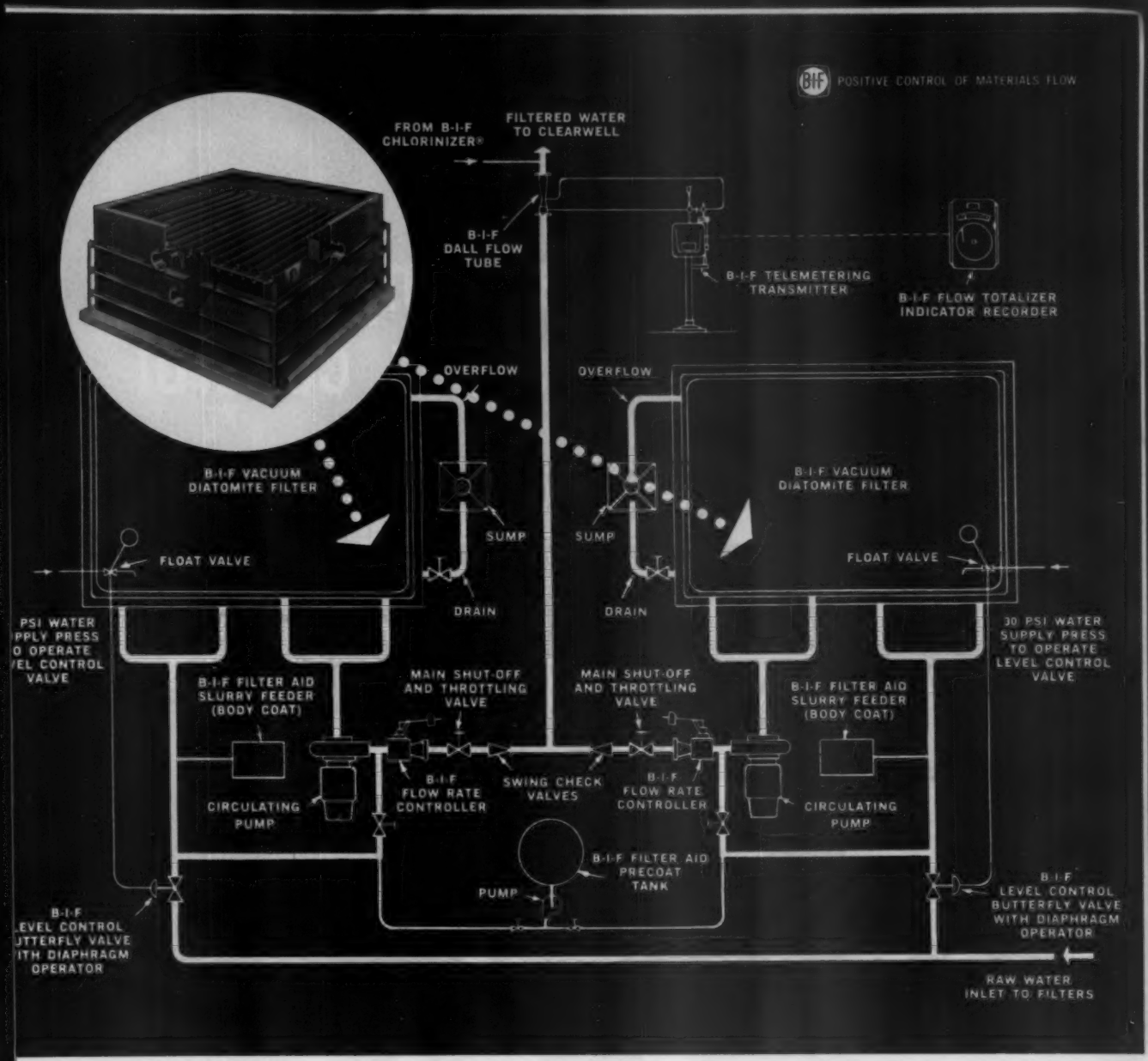
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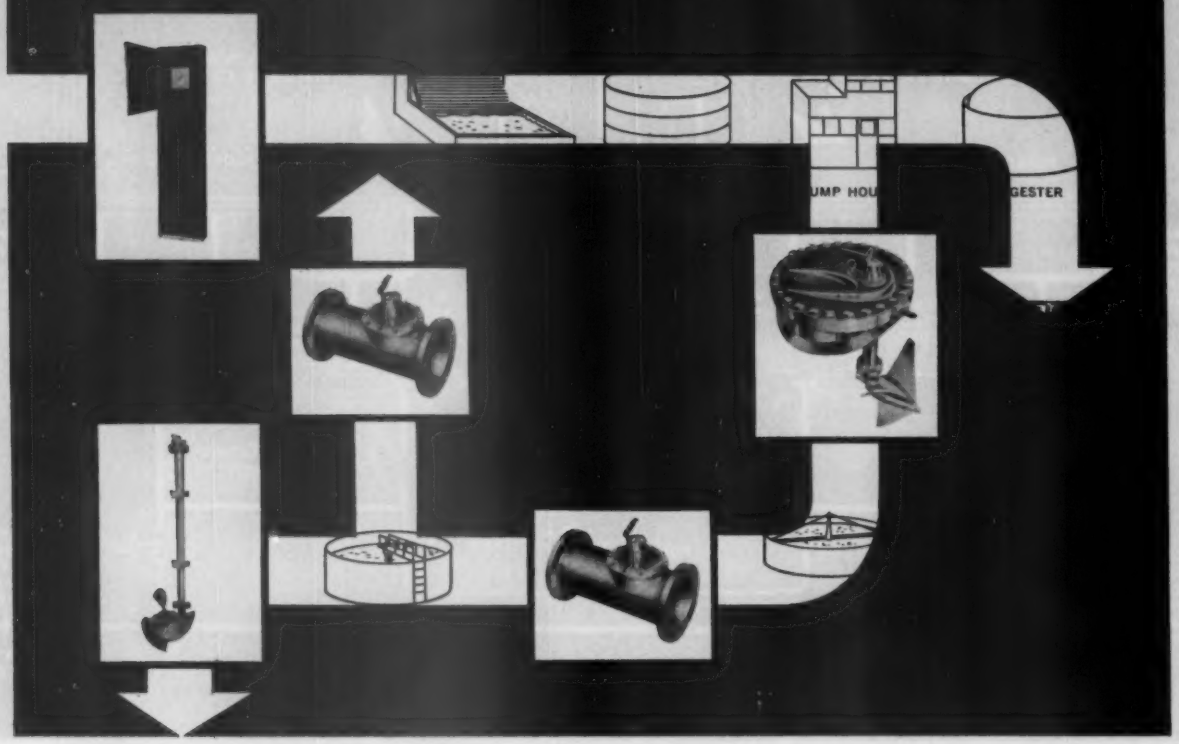

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INFLUENT. Continuous and instantaneous total flow information at the intake flume structure is obtained with a Sparling float operated indicator-totalizer providing dependable data for programming the entire plant operation. Total flow is registered on a straight reading 6-digit totalizer. Flow rate is indicated on a large black-on-white dial with sweep hand type pointer. Circular or strip chart recording can be incorporated within the indicator-totalizer at the inlet flume, or installed at convenient remote locations.

RETURN. Sparling propeller type meters may be placed at various locations within the plant to render continuous flow information. Sparling controls make chemical feeding more accurate. Better records are possible. Sparling Main-line meters are ideal for use in closed line sections, in open flow installations, or at similar metering points throughout the plant. Resilient plastic propellers function accurately in all return liquors.

EFFLUENT. A large Sparling open flow type meter at the plant discharge will totalize output for a final cross check of the entire operation. Sparling recording instruments provide permanent records for system study and for better treatment control. Applications for Sparling meters and instruments in both new and existing plants are numerous. Ask your Sparling field engineer for more details.

SPARLING
WATER CONTROL EQUIPMENT

HERSEY-SPARLING
METER COMPANY
Sparling Equipment: **EL MONTE, CALIF.**
225 North Temple City Blvd.

Branches: Atlanta • Chicago • Cleveland • Dallas • Denver • Kansas City, Mo. • Roselle, N. J. • San Francisco • Seattle • United Kingdom Affiliate: TYLORS OF LONDON LTD.

"I ended up with 'do-it-myself' service...

... did I get taken! I plead for pump service — and find out I'm talking to the salesman's telephone answering service. 'He's out in the territory,' they tell me . . . 'won't be back until Friday.' *Territory*, indeed! What am I supposed to do, organize a bucket brigade until Friday? Why can't that manufacturer hire someone to *service* pumps! Someone who fixes 'em for a living — not a salesman who just does service as a sideline."

Trained service at your command . . . one of the benefits of dealing with Allis-Chalmers. Industrial Equipment Division, **Allis-Chalmers,** *Milwaukee 1, Wisconsin.* A-1477

ALLIS-CHALMERS GIVES TRAINED SERVICE

At Allis-Chalmers, the servicemen "service" and the salesmen sell. Every regional office has available a network of specifically factory-trained men to service pumps "on the spot." Certified Service Shops can rebuild equipment quickly . . . save you transportation expense and time. When you call for service, you get service . . . from servicemen. The quickest and best offered by any pump manufacturer.

EQUIPMENT IN THE NEWS

For further information on products or services please use reader service card.

Electronic Leak Detector

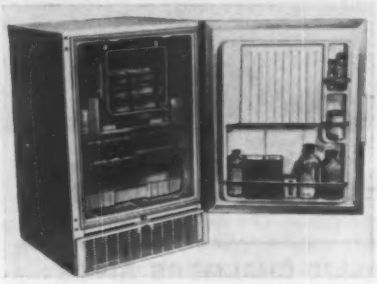
A new midget, highly sensitive, electronic leak detector has been announced by this manufacturer.

Tried and tested under varying conditions, the Model ML-61 has proved its superiority in detecting all types of water leaks under dirt, pavement, concrete, wood and other surfaces with rapid, pin-point accuracy.

The sensitive one inch square Rochelle Salts crystal microphone has a special mounting assembly which accepts the important leak vibrations and minimizes extraneous, unwanted sounds. An electronic filter circuit further assists the operator in detecting only the important leak noise.—Goldak Co., Inc.

Circle No. 901 on Reader Service Card

Lab Refrigerators and Freezers



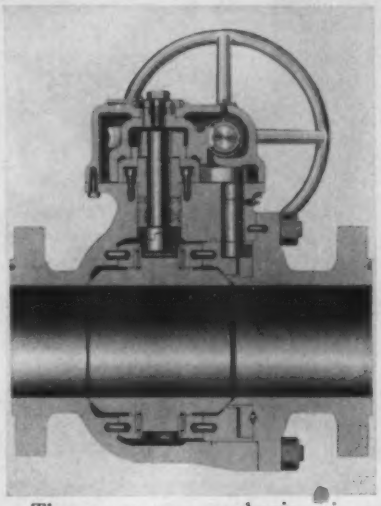
To meet the needs of research, quality-control, pilot-plant and mobile laboratories for on-the-spot refrigeration, this manufacturer has announced two versatile, compact units.

Laboratory Refrigerator Model 62, holds 4 cu ft. The fiberglas insulation is very effective: the refrigerator takes only 30 minutes to hit normal operating temperature (35° F) but takes 6½ hours to return to room temperature.

A 4.35 cu ft companion Lab Freezer Model 62 holds 150 lbs of frozen material. Lowest temperature (−14.8°F) is reached in just 90 minutes, but it's so well insulated it takes a full 8 hours to return to ambient.—Fisher Scientific Co.

Circle No. 902 on Reader Service Card

Worm-Gear-Driven Ball Plug Valve



This manufacturer has introduced a new worm-gear-operated version of its line of non-lubricated Ball Plug Valves. The new valve is said to operate easier and with less torque on the handwheel than other plug valves. Also contributing to ease of operation is plug mounted on sealed bearings.

The worm-gear mechanism is completely enclosed, protecting it from weather and accidental damage. Pneumatic, hydraulic or electric power operators can be furnished where required.—Hydril Co.

Circle No. 903 on Reader Service Card

Large Diameter Gasoline Boring Machine

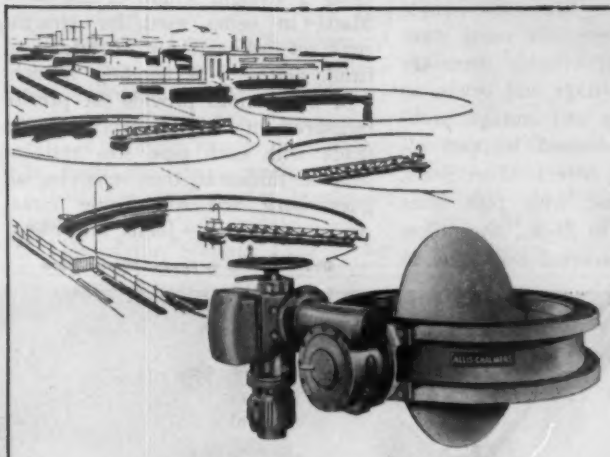
A gasoline powered horizontal boring unit capable of boring 36-in. diameter holes, has been announced by this manufacturer.

It consists of a 52 hp air cooled gasoline engine, hook rollers and engine base, three-speed transmission and gear reduction with clutch, 9 gpm hydraulic pump powering the feed mechanism, leveling outriggers, track, and connecting plates.

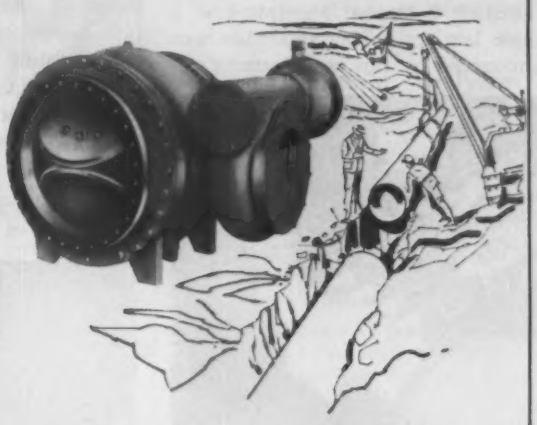
Ratings for the new machine range from 150 ft of 36-in. diameter hole to 200 ft of 12-in. diameter, both maximum calculations for drilling with casing. It is especially suited for water, sewer, electrical, and pipeline work.—Kwik-Mix Co., Div. of Koehring Co.

Circle No. 904 on Reader Service Card

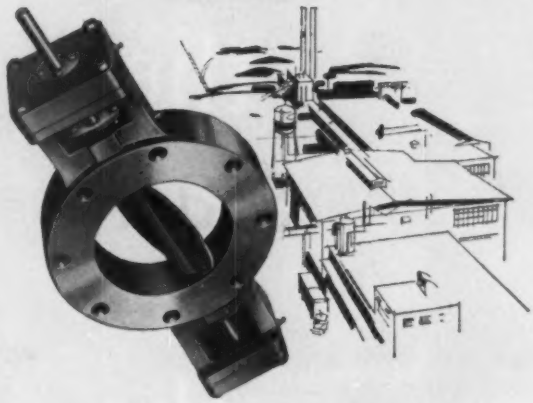
ALLIS-CHALMERS



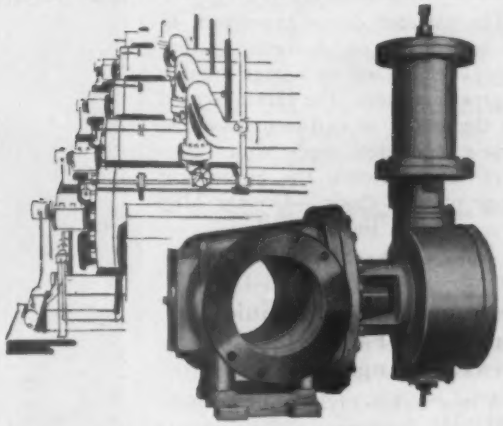
BUTTERFLY VALVES — For liquids or gases — uniform control in all positions, fast positive regulation and closure, minimum pressure drop. Compact and lightweight. Sizes from 1 in.



BALL VALVES — Easy manual shutoff under adverse conditions, and up to 150 psi. Slight wedging action gives unusually drop-tight closure. Sizes: 12 to 48 in.



WAFER VALVES — A new design of butterfly valves with space-saving flexibility, suited to most any type of operation. Sizes from 3 to 36 in., including high-pressure types.



ROTOVALVE — A cone valve suited to virtually any type of operation or location. Offers the least pressure loss, greatest initial shutoff, controlled closing time, positive seating.

Now: for power plants, sewage and water works —

a full line of rotary valves

Serving you even better through a broader line—Allis-Chalmers offers the finest in butterfly, ball and cone valves for industrial applications, power plants, sewage and water works. Also available are complete valving systems in standardized "packages" that provide *remote, telemetered control of valve operation.* These additions further round out Allis-Chalmers line that includes Angle, Needle, Relief valves, sleeve-type valves and accumulator systems. *For details, contact your Allis-Chalmers valve representative or write* **Allis-Chalmers,** *Milwaukee 1, Wisconsin.* Rotovalve is an Allis-Chalmers trademark.

A-1381

Equipment News

CONTINUED FROM PAGE 12A

Pipe Repair Clamp

A wrap-around pipe repair clamp featuring bolts on one side and a thick, butt-seal rubber gasket has been announced by this manufacturer.

The patented device provides a ⅜ in. adjustment on diameter so that a single clamp will fit a large number of pipe diameters. The clamp is used for the repair of cast-iron, asbestos-cement and steel pipes with diameters falling within the adjustment range of each clamp.—Dresser Mfg. Div., Dresser Industries, Inc.

Circle No. 905 on Reader Service Card

New Insulation Technique Simplifies Fabrication of Jacketed Angles

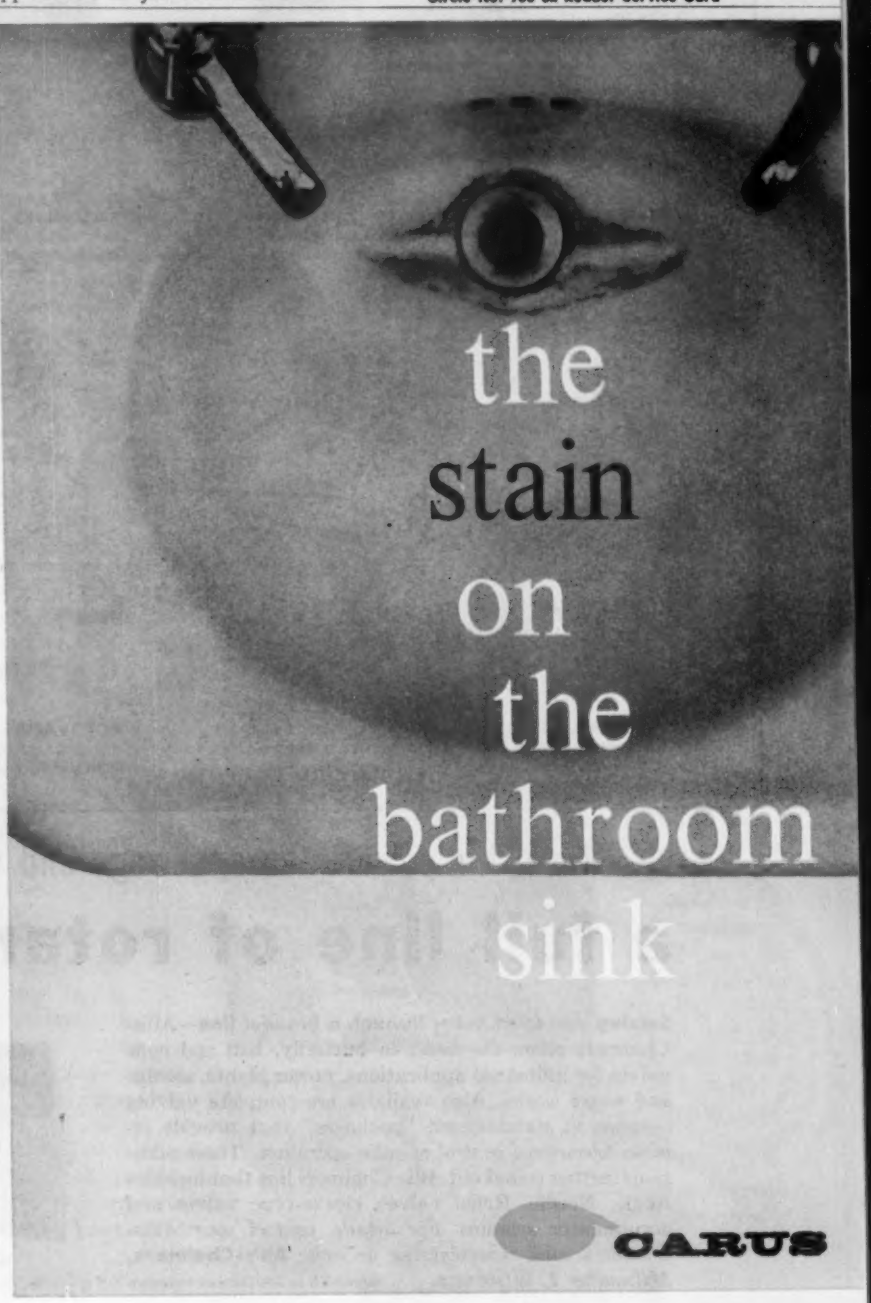
A new technique in applying jacketed pipe insulation allows job-site fabrication of aluminum-covered el-

bows, turns, sweeps, and bends directly from straight lengths. Developed by Johns-Manville for use with its Metal-On system, the time and money-saving method is made possible by a pre-formed band, called the "Miter-Seal."

Use of Miter-Seals for angle insulation eliminates the many complex operations previously necessary for insulating fittings and bends, as well as stocking and storage problems with pre-formed humped elbows and fitting covers. Miter-Seals, available for use with pipe sizes from ¾-in. up to 24-in., now allow application of jacketed insulation in many cases where it was not possible except on straight runs.

Fabrication of insulation for a fitting requires only a few steps, using a straight length of the same Metal-On being used for straight runs, an ordinary saw, a Miter-Seal band, and a J-M banding wrench. J-M instructions provide the precise measurements and angle cuts to be made with each pipe size and insulation thickness, thus removing all guess-work and minimizing measuring operations.—Johns Manville.

Circle No. 906 on Reader Service Card



Non-Linear Chart for Use With Type F Recorder

Measurement of liquid flow through 90° V-notch wiers can now be graphically recorded on a non-linear chart developed for use with the Stevens Type F Recorder. A similar non-linear chart is available for recording liquid flow over various sizes of Parshall flumes. Unit of flow readings can be taken visually from the charts without interpolation or reference to conversion tables.

Use of the Stevens Type F Recorder with non-linear charts for direct recording of liquid flow through standard measuring devices offers a low cost means of obtaining a permanent record of flow, especially suited for small sewage treatment plants or industrial concerns required to maintain a record of discharge into streams or sewage systems.—Leupold & Stevens Instruments, Inc.

Circle No. 907 on Reader Service Card

is a stain on your reputation
Eliminate iron and
manganese problems with
CAROX*
Potassium Permanganate
Efficient, economical CAROX Potassium Permanganate in your water system can prevent the annoying stains and clogged pipes caused by soluble iron and manganese.
CAROX goes right to work (in your present equipment), converting all of the dissolved iron and/or manganese to the corresponding insoluble oxides . . . which can then be readily removed by coagulation, sedimentation, and/or filtration.
You'll find that CAROX works rapidly, economically, and effectively, to improve the quality of your water . . . and your community's reputation. If you have problems with iron and manganese, write today to Carus Chemical Company, Inc., 1377 Eighth Street, La Salle, Illinois, for a free copy of our illustrated brochure, "CAROX Potassium Permanganate for Quality Water."
T.M.®
CHEMICAL COMPANY, INC.

Easy-to-Maintain Analyzer for Cl_2 Residuals

An easy-to-maintain analyzer for measurement and/or control of free or total chlorine residuals in water supplies and sewage effluents has been announced by this manufacturer.

Named "Anachlor", the amperometric-type analyzer is comprised of an analyzer unit and a potentiometer indicator or recorder calibrated in ppm chlorine residual. The two components occupy identical housings that can be mounted flush on a panel or can be installed separately from each other.

The Anachlor is recommended for continuous measurements of chlorine residuals in water treatment plants, distribution systems, sewage treatment plants, swimming pools and in industry.—Fischer & Porter Co.

Circle No. 908 on Reader Service Card

Metal-Tube Variable Area Flow Meter

This manufacturer announces a line of metal-tube variable area flow meters to complement its Glass-tube Varea-meters. These Metal-tube Varea-meters are used at temperature and pressures beyond the range of the Glass-tube type and for handling hazardous materials. They are supplied with ASA 150 and 300 lb flanges and conform to ISA Recommended Practices. Meters are supplied in a variety of materials to handle a wide range of industrial chemicals.

Metal-tube Varea-meters are made in tube diameters from ½ in. to 3 in. Water capacities range from one to 400 gpm and air capacities from 4.2 to 1680 scfm. These Varea-meters are supplied with a magnetic indicating extension, or optionally with a transmitter to operate recorders, controllers or integrators.—Wallace & Tierman Inc.

Circle No. 909 on Reader Service Card

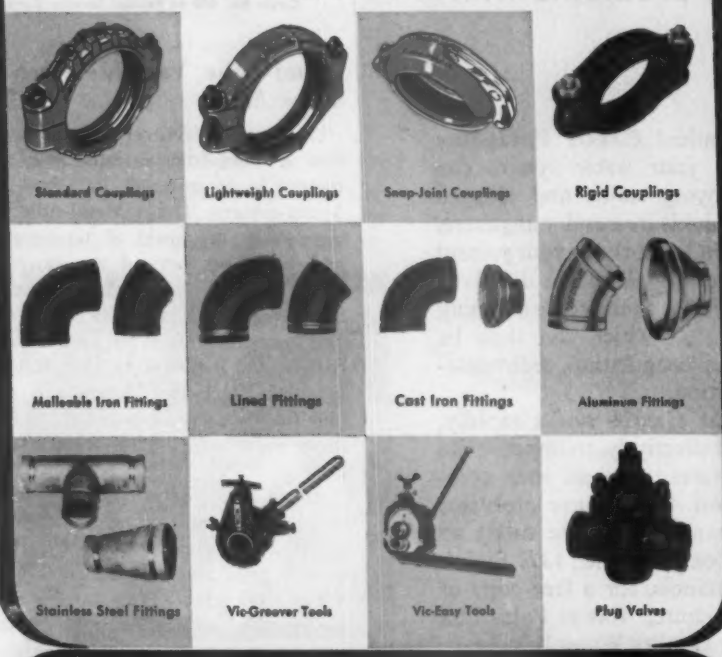
CONTINUED ON PAGE 16A

let VICTAULIC cut your piping costs

NEW PLAINLOCK COUPLINGS AND FITTINGS
For Low Cost Jointing of Plain End Pipe

- Speed Installation — Save Time and Labor — Cut Piping Costs
- No pipe end preparation
- Positive grip of pipe ends
- Low cost couplings and fittings
- Join standard or light wall carbon or stainless steel, aluminum and other piping materials

CUT COSTS WITH OVER 1100 VICTAULIC ITEMS FOR BETTER AND EASIER PIPING



For complete information on any Victaulic product, write:
VICTAULIC COMPANY OF AMERICA
P.O. Box 509, Elizabeth, N.J.

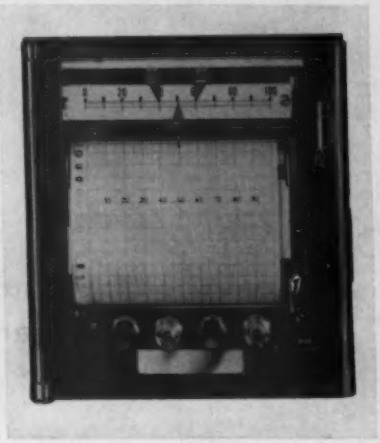
Equipment News

CONTINUED FROM PAGE 15A

4-Inch Telemeter Receiver

A new line of 4-inch chart width telemeter receivers (Series 670) has been announced by this manufacturer.

Designed to fit any Metameter® telemetering system, the new instruments are offered with one or two retransmitting slidewires, and a maximum of four individually adjustable alarm contacts. Each alarm contact has an individual scale. Two



of the maximum eight alarm contacts can be set from the front of the instrument.—The Bristol Co.

Circle No. 910 on Reader Service Card

Compact Sewage Treatment Plant

A new series of compact sewage treatment plants, suitable for housing developments, industrial plants and the light construction market in general, has been made available on a purchase or lease-rental program by this manufacturer. A distributor-service organization is being organized so that the developer or apartment or business operator in any part of the United States can obtain installation and continuing maintenance and operating service under either the purchase or rental plan.

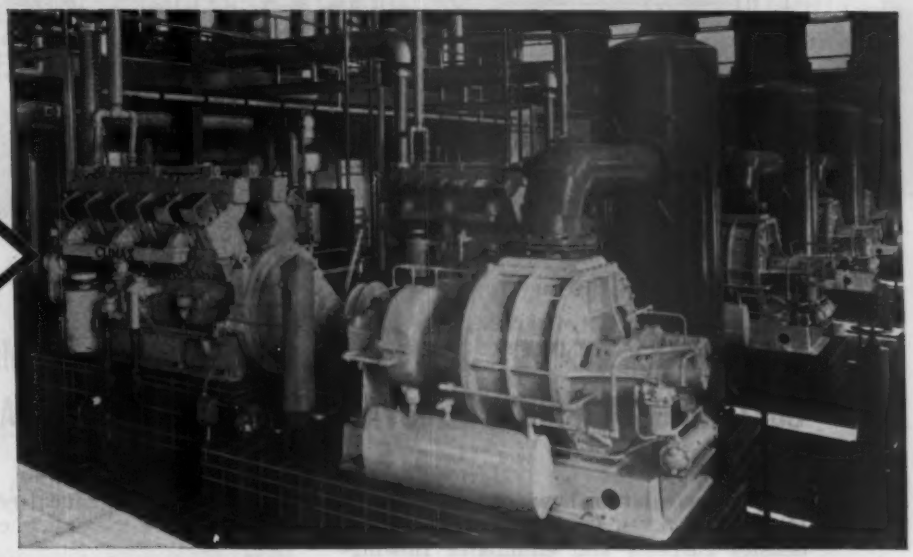
The new compact sewage treatment plants utilize the well-established Biofiltration process. Standard designs, based on a 24-hour run-off, cover a

CONTINUED ON PAGE 86A

in this Mansfield, Ohio $4 Million sewage plant...

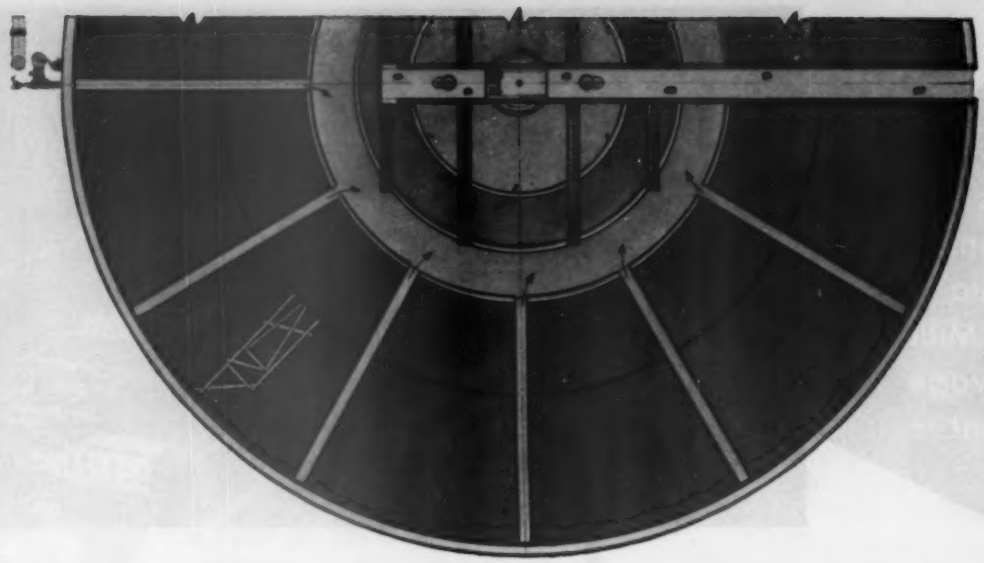
A SLUDGE GAS CLIMAX POWERS EACH 5250 cfm BLOWER

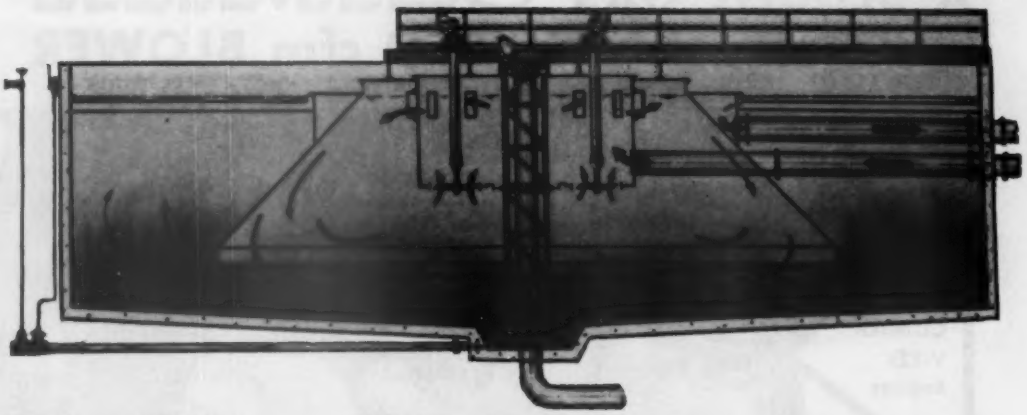
Four CLIMAX V-125 Engines



Mansfield, Ohio, puts money back in the taxpayer's pocket with Climax Power *economy*. In its recently completed sewage treatment plant, digester gas fuels the four Climax Engines driving the blowers. Used for aeration, grease and grit removal, are four 18 x 21 RCDH Roots-Connersville blowers. Capacity of each blower is 5250 cfm. And each has a V-125, 12-cyl., 7½ x 7-in., 3711 cu. in. displ. Climax Engine operating on sludge gas at 650 rpm and delivering 225 hp. • Engineering Controls, Inc., St. Louis, Mo., supplied the vapor phase cooling system. Floyd D. Browne & Associates, Marion, Ohio, are the Consulting Engineers. • *Send for bulletins* on Climax sewage plant engines: 12, 8, 6 cyl.; sludge gas, or natural gas, butane, gasoline, or any combination fuel; 100 hp to over 600 hp. CL-120

CLIMAX ENGINE MANUFACTURING CO. • DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY—CLINTON, IOWA





Clariflow HC Series... LIME SODA-ASH

SOFTENING-TURBIDITY REMOVAL-CHEMICALLY PRECIPITATED WASTES

Clariflow Inlet for flow-thru control. The tried and proven Clariflow Inlet controls density currents and eliminates flowing-thru short-circuiting.

Four or six to one (or even ten to one) internal recirculation for ultimate in particle contact.*

Accelerated chemical reaction and flocc formation for maximum clarification.

Heavy duty sludge collector for positive sludge removal and sludge blow-off control.

Wide range of sizes and capacities for circular or square basins.

**Where controlled, lesser amounts of contact with the previous precipitate are desired, refer to Walker Process S & R Series Clariflows designed with outside, pumped slurry return.*

WALKER PROCESS

Walker Process Equipment Inc.

FACTORY • ENGINEERING OFFICES • LABORATORIES • AURORA, ILLINOIS

MUELLER®

ORISEAL® VALVES NOW RATED AT 175 P.S.I. AND 180°F.

The more positive seal provided by the Mueller Oriseal Valve has resulted in both the maximum water working pressure and test pressure being raised 40% . . . to 175 p.s.i. At the same time, maximum water temperature ratings have been boosted 20% to 180°F. Offering advantages found in no other curb stop, the Oriseal has a "Teflon"* coated, balanced plug that requires no lubrication or maintenance, yet turns freely even after many thousands of operating cycles.

New . . . Oriseal with Minneapolis Pattern!

Mueller Oriseal Curb Valves in the ¾" and 1" sizes available with Minneapolis threads and matching curb boxes.

*DuPont Company registered trademark

New Oriseal Curb Valve Specifications

- Full Round Way Opening
- Solid Tee Head with ¼" rod hole
- Quarter Turn with Check
- 175 p.s.i. Water Working Pressure
- 175 p.s.i. Test Pressure (Every Oriseal Valve is tested with 175 p.s.i. air pressure under water in both open and closed positions—a much more exacting test than hydrostatic testing)
- 180°F. Maximum Water Temperature
- Sizes: ¾", 1", 1¼", 1½", 2" (¾" and 1" also offered with Minneapolis Pattern)
- Inlet and/or Outlet available with Inside I.P. Thread, Mueller Copper Service Pipe Connection

Write for complete information and specifications.

MUELLER CO. Since 1857 SERVING Water and Gas Industries QUALITY

6234

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Factories at: Decatur, Chattanooga, Los Angeles
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Newport News rack rakes . . . minimum-manpower way to keep water intakes free of debris

Newport News mechanical rack rakes are power-operated rakes for cleaning trash racks at water intakes, including those at hydro-electric plants, steam plants, pumping stations, and similar installations throughout this country and abroad. Under ordinary conditions, one man per shift keeps racks clean for a dozen bays.

Operate in channel guides for maximum cleaning action

A Newport News rake *won't ride over trash* nor will its teeth drop the debris, because the rake operates in channel guides for positive action. Special teeth are available for cleaning racks of filamentous algae, seaweed, etc.

The Newport News mechanical rack rake has been built to operate in bays from 5 feet 6 inches wide to 28 feet 6 inches in width. Forebay design determines the maximum width for a single rake. In the case of a very wide bay, intermediate guides are sometimes used to reduce the length of the rake. There are many typical installation arrangements to fit your needs. Newport News engineers are prepared to individualize these designs for you.

If you have a debris problem, write for a copy of THE NEWPORT NEWS MECHANICAL RACK RAKE, an illustrated booklet describing the installation, operation, and advantages of a Newport News rake.

Engineers . . . Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

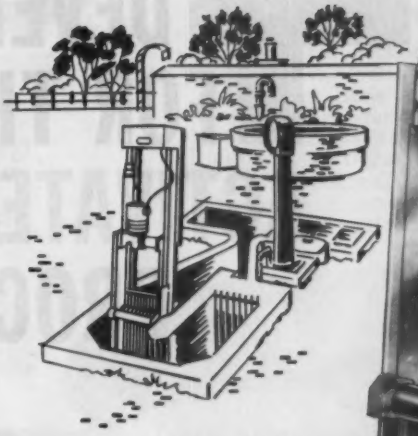
Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

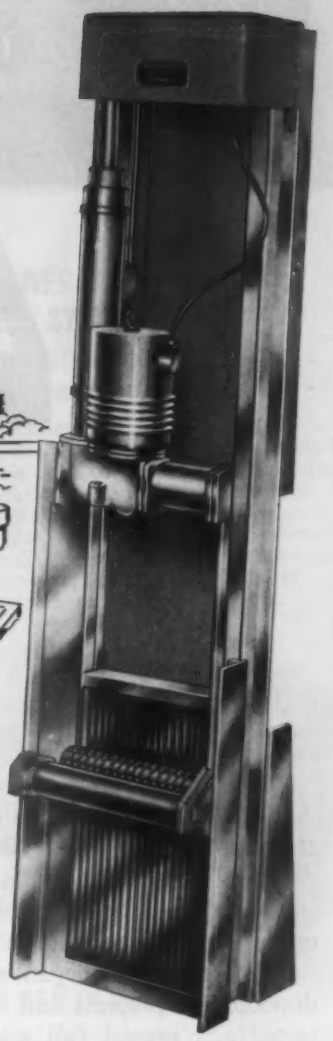
"from Chicago"

LOWER COST COMMINUTION FOR RECTANGULAR CHANNELS...

THE MODEL "C" BARMINUTOR WITH THESE NEW FEATURES

- Automatic safety slip-clutch
- Counter-weighted to minimize friction . . . increasing life of machine
- Stainless Steel Screen
- Ball Bearing Shoes
- Single Motor Drive . . . lower operating horsepower required
- Reversible cutting to provide increased cutting capacity and extended cutter life
- Rugged, economical design and construction



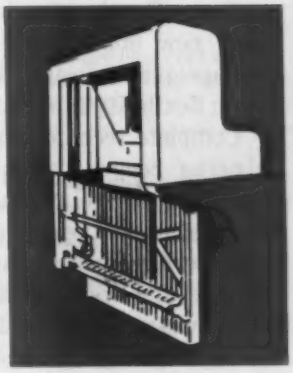


Provides continuous, complete, automatic screening and comminution without removal from flow. Is operated and maintained at lower cost than any similar device. Eliminates unsightliness, nuisance and odor. Requires less power.

OTHER "CHICAGO" COMMINUTING MACHINES

THE ORIGINAL COMMINUTOR

The original Comminutor, developed by Chicago Pump provides continuous screening and cutting of coarse sewage matter for use in hydraulically designed feeder basins. Sized for flows of .175 to 25 MGD per machine.



MODEL "A" BARMINUTOR

All electric drive reversible screening and comminuting machine for handling high flows in rectangular channels four to eight feet wide. Shear bars produce extra cutting capacity without corresponding increase in power requirement. Neat, compact drive motor and panel.

fmc CORPORATION

HYDRODYNAMICS DIVISION

CHICAGO PUMP

622 Diversey Parkway • Chicago 14, Illinois

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Results of a continuing research program by **DORR-OLIVER**

4 ADVANCED DEVELOPMENTS FOR THE ACTIVATED SLUDGE PROCESS

As important results of a continuing sanitary research program, Dorr-Oliver® now presents four major contributions towards improving the efficiency and simplifying the operation of the activated sludge process.

These advances began as research and development projects and have emerged as tested and proved full scale installations. They climax almost ten years of effort aimed at producing a complete line of aeration and clarification equipment.

They offer the consultant or sanitary engineer new opportunities for more efficient sewage plant design, together with maximum flexibility in meeting particular needs.

Complete technical information and convincing records of operation in several installations are available. In addition, the knowledge and experience of Dorr-Oliver engineers, gained in handling every type of sewage and waste treatment problem, are at your service. Write Dorr-Oliver Incorporated, Stamford, Connecticut – or use the convenient coupon at right.

THE D-O INKA AERATION SYSTEM

A unique new design concept

Based on a new principle of operation utilizing large volumes of low pressure air supplied by simple, low-cost ventilating-type fans, the D-O INKA System provides high oxygen absorption rates, high circulating velocities and optimum mixing conditions. Clog-resistant aeration grids are of an entirely new design. The result is an outstandingly simple system with exceedingly low maintenance and power costs.

THE DORR-OLIVER SPIROVORTEX® SYSTEM

High purification with maximum simplicity

This system combines the simplicity of Biofiltration® with the efficiency of activated sludge treatment. Basic units comprise two SpiroVortex mixing tanks for contacting activated sludge with settled sewage, the Dorr-Oliver-designed SUPERATE® Distributor and Filter and primary and secondary clarifiers. The SpiroVortex system provides an excellent settling sludge and is capable of purification in excess of 90%.

THE D-O® AERATOR

A proven method for meeting increased oxygen demands

The D-O Aerator is a high capacity, motor driven mixing unit specifically designed to meet the high oxygen demands of concentrated activated sludges found in the newer short period processes. Turbine type impellers promote maximum turbulence for high absorption capacity and complete mixing. Units are adapted to installation in all sizes and shapes of tanks.

THE DORR® RSR CLARIFIER

for rapid sludge removal

This unit solves the problem of excessive sludge detention in final clarifiers. Rotating uptake pipes continuously remove high volatile sludge from the tank floor, while grit and low volatiles are raked to a central sump. Quality and quantity of sludge removed from the floor of the clarifier can be readily observed and its rate of removal can be controlled by accessible, simple adjustments.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

Complete literature available

Technical bulletins covering each of these Dorr-Oliver developments are available to you. For your copies, write to Dorr-Oliver Incorporated, Stamford, Connecticut, or use the coupon at right.

Dorr-Oliver Inc., Stamford, Connecticut

Please send me bulletins on the D-O INKA AERATION SYSTEM (No. 7318), THE D-O AERATOR (No. 7316), THE DORR-OLIVER SPIROVORTEX SYSTEM (No. 7314), AND THE DORR RSR CLARIFIER (No. 6194).

Name_____

Address_____

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An engineer from Arizona reports:

"Transite is a sound pipeline investment now and for the future."

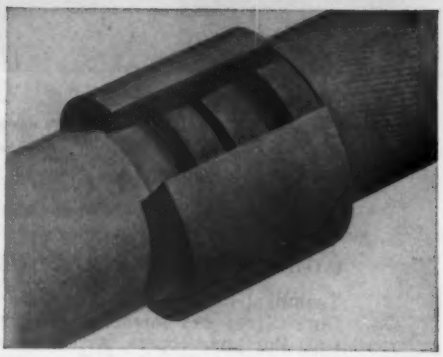
A. H. Beard, Jr.
Consulting Engineer
Tucson and Phoenix, Ariz.

"When considering a pipe material for water and sewage projects, 'value' analysis plays an important part in our choice. One of the main questions is whether the pipe will perform reliably now *and* in the future with cost advantages to the client.

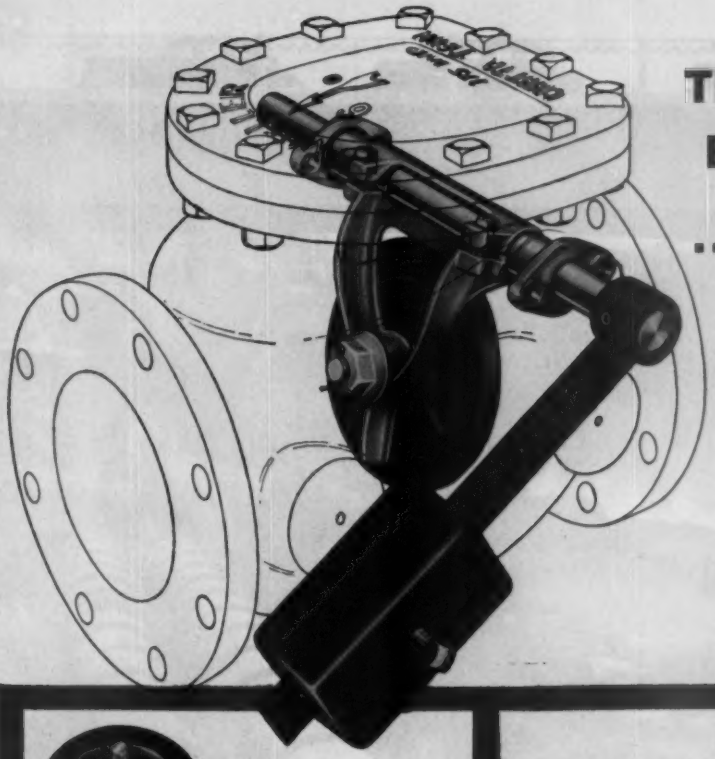
"Experience has shown that Johns-Manville Transite® Pipe offers the value we seek. It has proved reliable and at very favorable costs. In addition to savings in handling and installing, Transite's unique Ring-Tite® joints assure that leakage tests will not upset job costs. In numerous tests, Transite lines have regularly been under the 'allowable' specification.

"Installations as old as Transite itself show this pipe outstanding under flexure, crush and hydrostatic conditions. Lengths of Transite excavated here in Arizona for tests showed no signs of internal corrosion after 20 years of dependable service."

For full details, write to Johns-Manville, Box 362, WS-9, N. Y. 16, N. Y. In Canada: Port Credit, Ontario. Cable: Johnmanvil.



JOHNS-MANVILLE JM



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...and the difference is MUELLER QUALITY

Compare the parts of a Mueller heavy-duty Check Valve with those of conventional check valves. In each comparison, Mueller parts are either larger, more accurately manufactured or of higher strength materials.

The result is longer service life and more dependable operation without maintenance.

The Heavy-duty Check Valve is typical of the extra care, extra quality built into every Mueller product.

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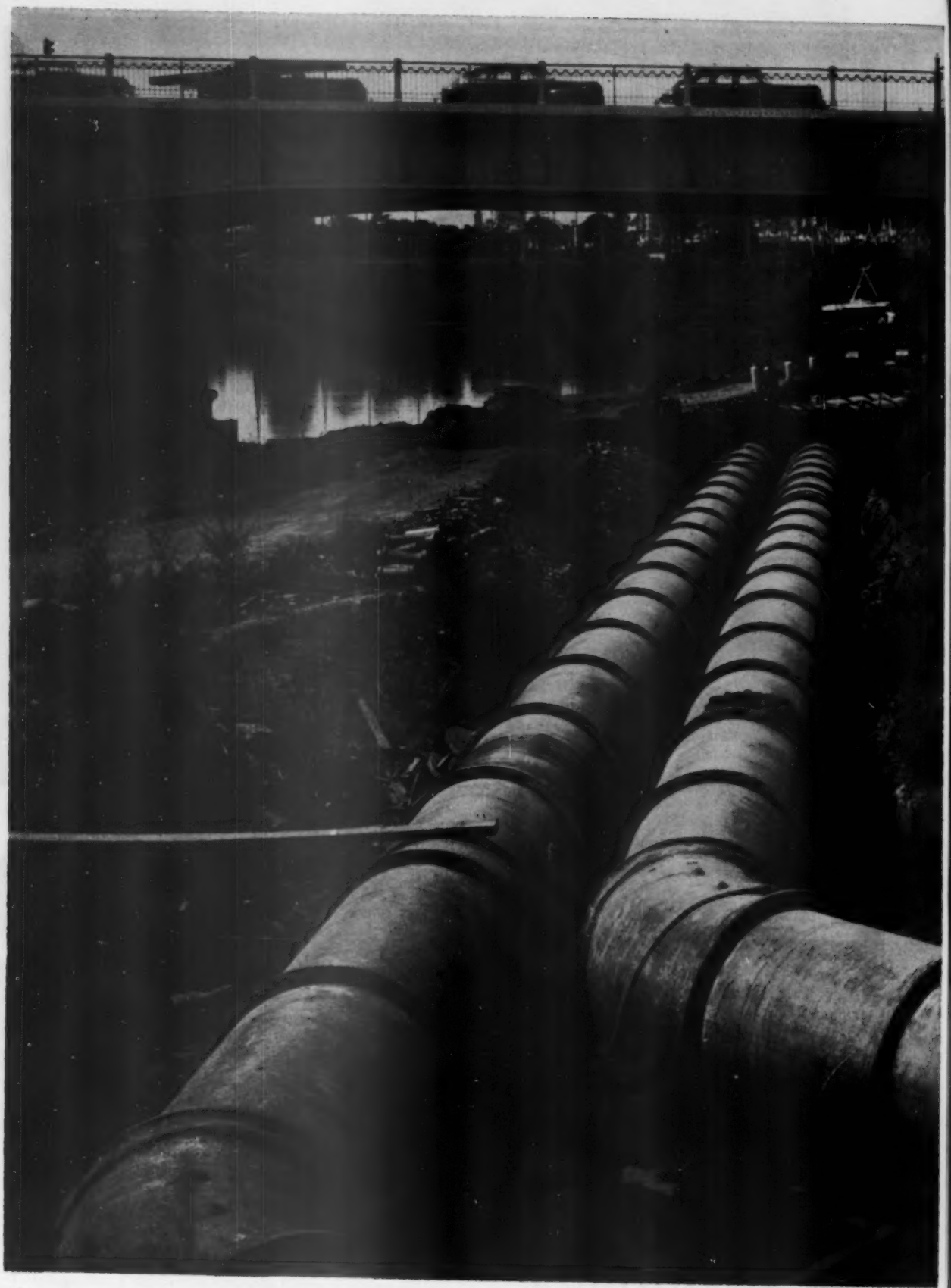
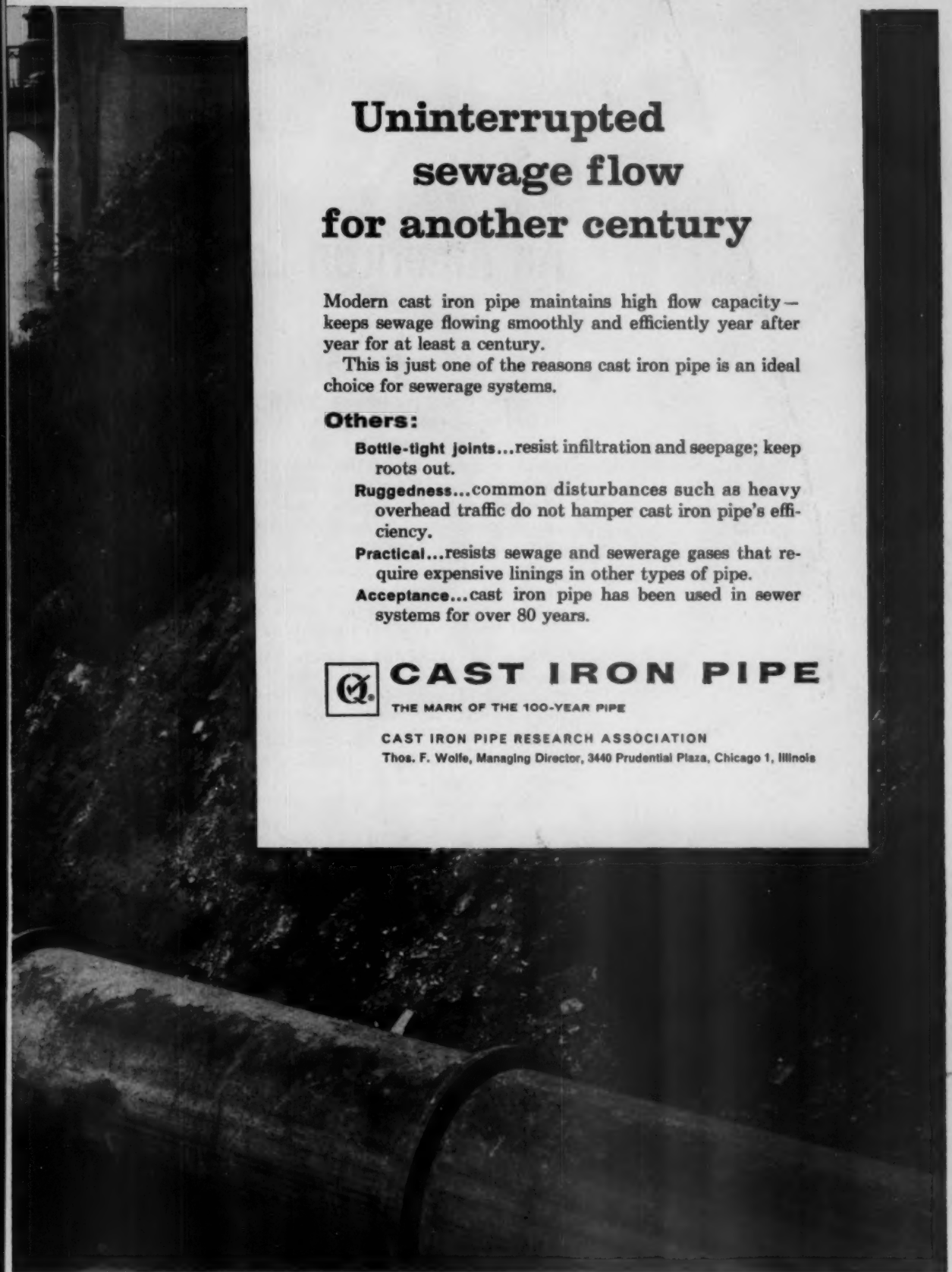




Uninterrupted sewage flow for another century

Modern cast iron pipe maintains high flow capacity—keeps sewage flowing smoothly and efficiently year after year for at least a century.

This is just one of the reasons cast iron pipe is an ideal choice for sewerage systems.

Others:

Bottle-tight joints...resist infiltration and seepage; keep roots out.

Ruggedness...common disturbances such as heavy overhead traffic do not hamper cast iron pipe's efficiency.

Practical...resists sewage and sewerage gases that require expensive linings in other types of pipe.

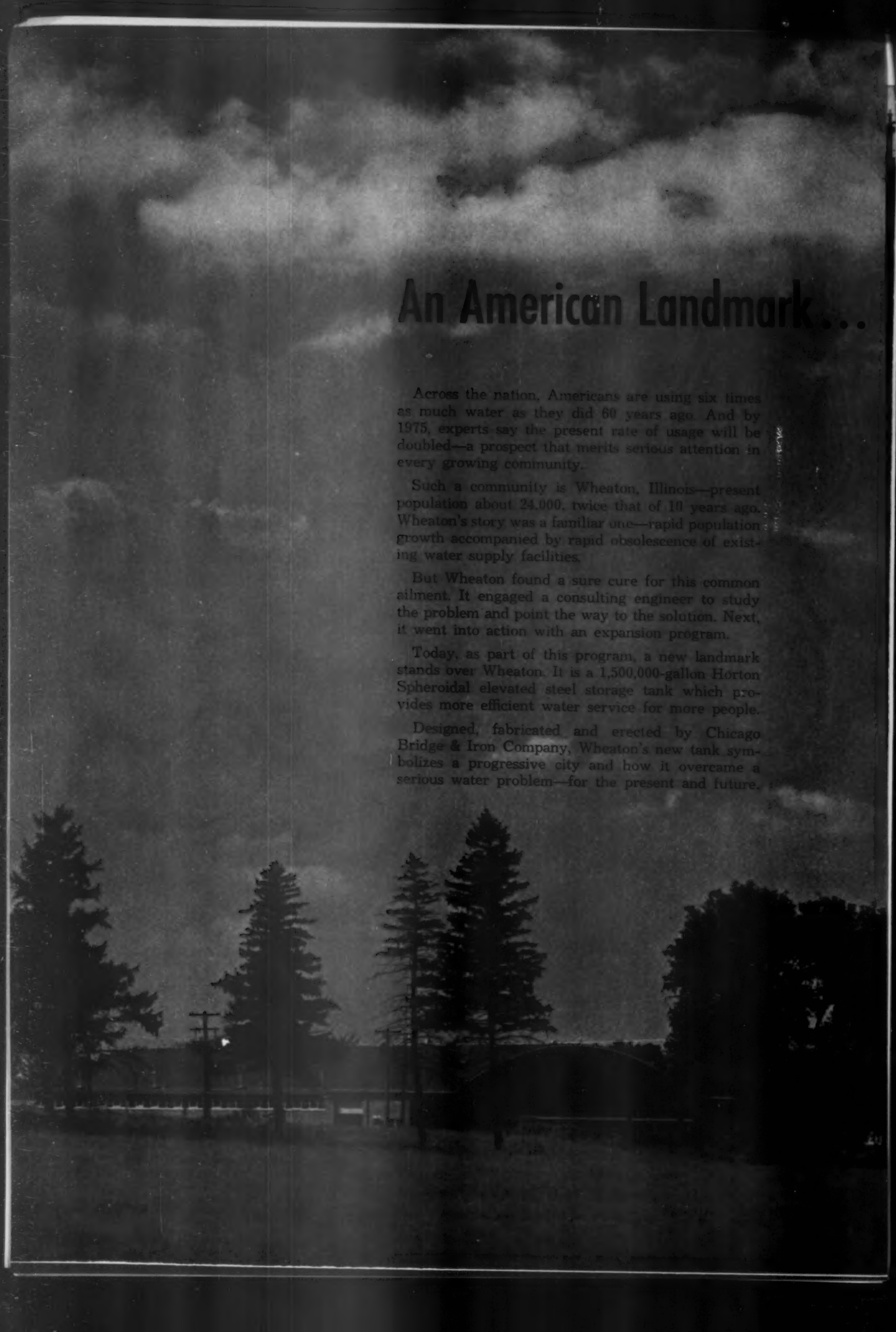
Acceptance...cast iron pipe has been used in sewer systems for over 80 years.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois



An American Landmark...

Across the nation, Americans are using six times as much water as they did 60 years ago. And by 1975, experts say the present rate of usage will be doubled—a prospect that merits serious attention in every growing community.

Such a community is Wheaton, Illinois—present population about 24,000, twice that of 10 years ago. Wheaton's story was a familiar one—rapid population growth accompanied by rapid obsolescence of existing water supply facilities.

But Wheaton found a sure cure for this common ailment. It engaged a consulting engineer to study the problem and point the way to the solution. Next, it went into action with an expansion program.

Today, as part of this program, a new landmark stands over Wheaton. It is a 1,500,000-gallon Horton Spheroidal elevated steel storage tank which provides more efficient water service for more people.

Designed, fabricated and erected by Chicago Bridge & Iron Company, Wheaton's new tank symbolizes a progressive city and how it overcame a serious water problem—for the present and future.

WHEATON

...15 seconds with Fairbanks-Morse Diesels

The F-M 38D8⅛ Opposed-Piston Diesel Generating Unit—with only 15 seconds *from cold start* to full power—gives fast, sure power for peaking or for standby use, together with impressive operating economies.

This unit requires no spinning reserve . . . uses no power until it starts, then produces up to 2500 kw per unit. Can be linked in multiple units.

Dependable? Service records of F-M Diesels prove dependability beyond a doubt (F-M pioneered the manufacture of diesels in America . . . has kept in the forefront ever since.)

Economical? The 38D8⅛ has 40% fewer moving parts than comparable engines of equal horsepower. This means reduced maintenance costs . . . fuel and lube oil savings.

Opposed-piston design minimizes vibration, produces fine balance . . . smooth power and instant response that result in 15 second full-power operation. Available with 4, 5, 6, 8, 10 or 12 cylinders, ranging from 450 to 2500 kw per unit, with automatic or manual controls. **For full details or custom specifications, write today to: S. K. Howard; Director of Marketing; Fairbanks, Morse & Co.; Beloit Division; Beloit, Wisconsin.**

FAIRBANKS MORSE
A MAJOR INDUSTRIAL COMPONENT OF
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10 Foot View Of 26,050 Foot Water Line

A little bulldozer was used to good advantage on this 48-inch five-mile water supply line in Columbus, Ohio. The first job it did for the Complete General Contracting Company of Columbus was to level the bottom of the trench and prepare a bed for the pipe.

After the crane lowered the pipe, a workman placed blocking in the bell and the little dozer shoved the pipe home as shown in the picture at the top of the page. The line was installed under the direction of Ernest H. Stork, Director, Department of Public Service and Frank Wright, Superintendent, Division of Water, Columbus, Ohio.

On other parts of the job, a backhoe was used to dig the trench, place the pipe and shove the joint home. Burgess & Niple of Columbus were consulting engineers. The pipe was manufactured by Price Brothers Company, Hattiesburg, Mississippi and Dayton, Ohio.

Price Brothers
CONCRETE PRESSURE PIPE

Space Age Sewage Treatment

ABOVE: Dual "Oxigests" provide a total capacity of 47,500 gallons per day to serve this large, outlying military installation. The treatment facility is equipped with comminutor, foam control system, sludge storage tank, chlorine contact tank, hydrochlorinator housing and weir box.

BELOW: Single installation of 18,750 gallon "Oxigest" sewage treatment plant, with same equipment as above, serves a smaller military site.

S&L These Smith & Loveless "Oxigest" factory-built sewage treatment plants are representative of many such installations serving military posts and civilian developments throughout the United States and Canada.

For small communities, shopping centers, apartments, mobile home parks, schools, motels, factories, and growing subdivisions—in outlying areas where there is no municipal sewage treatment system, the "Oxigest" provides dependable sewage treatment. The long-period "Aerobic Digestion" treatment process of the "Oxigest" provides maximum treatment efficiency with minimum maintenance.

Smith & Loveless "Oxigest" sewage treatment plants are available in a variety of sizes . . . in factory-built units that are delivered to the job site, ready for installation, and in large, field-erected units for capacities to 5,000 persons. — Address: Department 20

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P. H. Van Orden, President, C. L. Peterson, Vice-President and Treasurer, and R. H. Webb, Foreman of the Van Orden Company, Contractors, of Grand Rapids, Mich., supervise the installation of "K&M"® Asbestos-Cement Sewer Pipe at Paw Paw, Mich.

10,000 FT. OF SEWER PIPE LAID...

. . . not enough infiltration to measure

Read how the Van Orden Company solved the problems of installation and of infiltration when pipe had to be laid 9 ft. below the water table.

"the ease of handling and assembly saved us dollars and time!"

P. H. Van Orden

"Construction of the Paw Paw trunk sanitary sewer called for installation of pipe at depths up to 19 feet, where water table was at 10 feet. Infiltration had been the major problem in other sewer installations in the area. We solved this problem by using "K&M" Asbestos-Cement Sewer Pipe with its FLUID-TITE joint. With 10,000 feet of sewer in, we haven't had enough infiltration to measure.

"The longer laying lengths and the speed with which a joint can be made are definite time-saving factors, which have added to our production. Less time spent grading pipe and handling material means dollars saved."

Rigorous tests prove "K&M" Asbestos-Cement Sewer Pipe is infiltration-tight at 25 psi . . . a pressure equivalent to that of a 58-foot head of water.

"K&M" Asbestos-Cement Sewer Pipe wont rust, rot, or corrode. Its smooth bore remains clean, permanently. Flatter grades are possible. Fewer lift stations are required.

Maintenance-wise, the village of Paw Paw, Mich., will enjoy tax savings. "K&M" Asbestos-Cement Sewer Pipe is practically indestructible. Requires fewer inspections, because root growths do not penetrate the exclusive FLUID-TITE coupling.

Write today for more information on "K&M" Asbestos-Cement Sewer Pipe to: Keasbey & Mattison Company, Ambler, Pa.

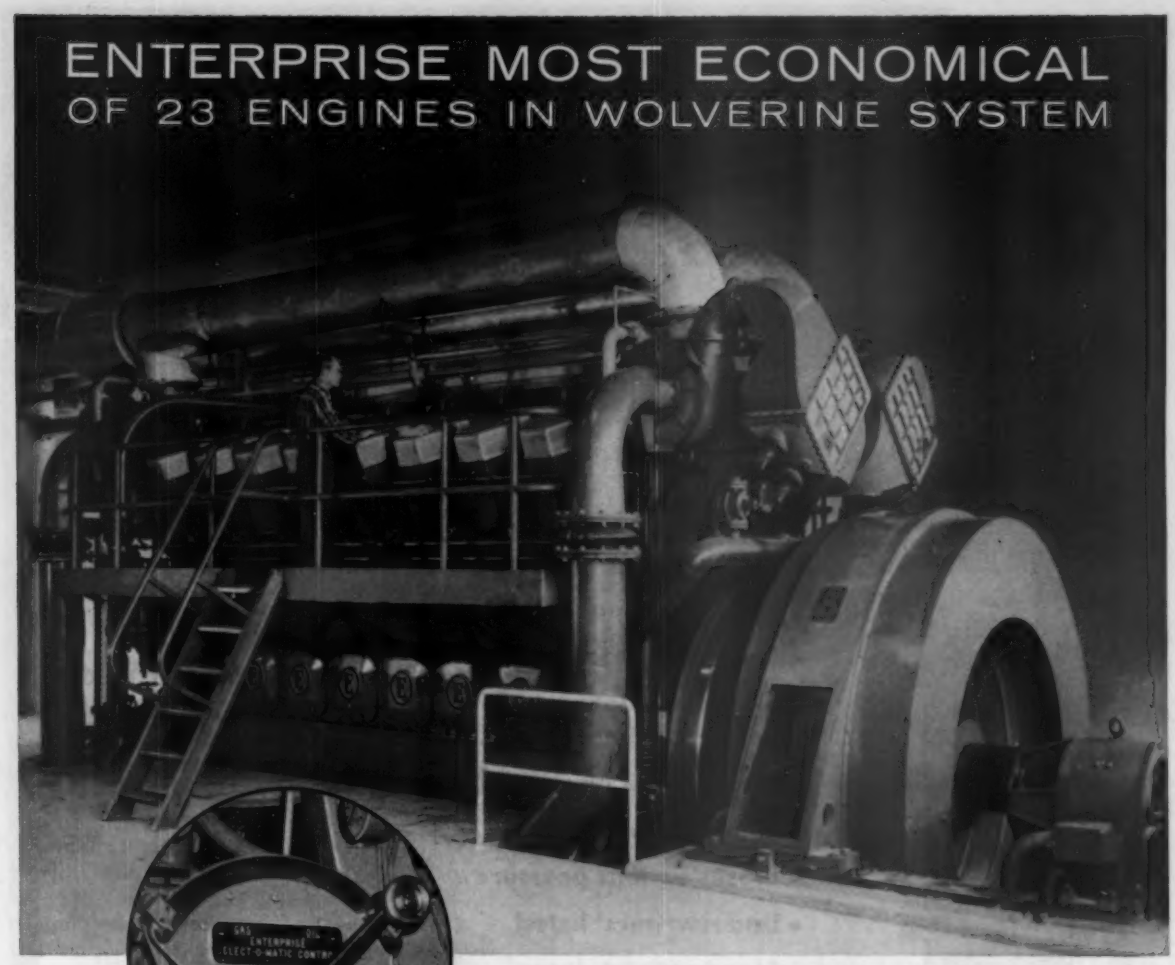
Keasbey & Mattison at Ambler

K·M BEST IN ASBESTOS

Two-step assembly! Lubricate the tapered end of "K&M" Asbestos-Cement Sewer Pipe, then slide it into the exclusive, patented "K&M" FLUID-TITE® Coupling.

Light weight reduces shipping and handling costs...saves on installation time. At the same time, there's a minimum of wastage and breakage on the job, with tough "K&M" Asbestos Sewer Pipe.

ENTERPRISE MOST ECONOMICAL
OF 23 ENGINES IN WOLVERINE SYSTEM



- LOW OPERATING COST
- OUTSTANDING SERVICE
- EASE OF MAINTENANCE
- INHERENT POWER RESERVE
- SIMPLE FUEL CONTROL (SELECT-O-MATIC®)

Wolverine Electric Cooperative, Inc., headquartered at Big Rapids, Michigan, chose this Model DGSRV-16-3 Enterprise 16-cylinder Turbo-charged Dual Fuel Engine to power its Van Dyke Plant at Burnips, Mich., because of low installation cost and Enterprise's enviable reputation for fuel economy in dollars per kilowatt. Read what James O. Wood, Superintendent of Production, has to say about Enterprise economy and performance:

"Our Enterprise engine is one of the most economical in our system, which consists of 23 engines and includes five different makes. We are especially pleased with the operation of the Enterprise 'Select-O-Matic'® controls, and the ease of engine maintenance. Enterprise service has been outstanding."

Rated 3500 KW, 4890 BHP at 360 rpm, Wolverine's versatile Enterprise, operating on fuel oil and gas, produces power at the extremely low cost of only 3.56 mils per KWH including maintenance, based on gas cost of 35¢ per M/cu.ft., and fuel oil cost of 10¢ per gal. This engine has produced over 4000 KW when called on for emergency.

For dependable, low-cost power on any municipal or industrial installation, Enterprise heavy duty Engines are designed for the most exacting requirements — in electric power generation, sewage plant power and for pumping systems. Models available from 73 to 7703 hp, with fueling in diesel, dual fuel, tri-fuel or spark-ignited gas. Call or write today for complete information.

ENTERPRISE *Diesels*

THE DEPENDABLE

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EDDY New Improved Products Meet Modern Needs

EDDY Fire Hydrant

- **Improved, streamlined, modernized**
- **Optional break-flange**
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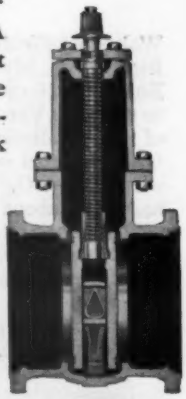
- **New self-sealing main valve packing**
- **Requires no lubrication**
- **Opens *with* pressure**
- **Closes *against* pressure**
- **Underwriters' listed**
- **Standardized, interchangeable parts**

EDDY Check Valves

Completely new designs of horizontal swing check valves are available in sizes from 4 through 12 inches. They operate dependably in either vertical or horizontal positions and incorporate construction features which provide unusual flexibility of operation. These valves may be converted in the field from plain to single- or double-lever operation to meet changing requirements. Other check valves up to 24 inches.

EDDY Gate Valves

In addition to the regular line of EDDY Taper Seat AWWA gate valves, EDDY now offers a newly designed parallel seat AWWA gate valve in sizes through 12 inches. This valve has been specifically engineered to provide long, trouble-free service. Working parts are designed with heavy, thick section and large seating surfaces for dependable operation and improved wearing qualities. The valve has two-point, free-floating wedging for minimum friction and maximum operating ease. Other AWWA gate valves are available through 48 inches.



Whatever your waterworks requirements, it will pay you to have full information on the complete EDDY *line of valves and hydrants.*

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.
WATERFORD NEW YORK

Are your customers drinking like fish?

AQUA NUCHAR
ACTIVATED CARBON
for taste and odor control

Do they quench their thirst with *water* . . . or are you driving them to drink?

Americans today are more discriminating than ever in what they eat and drink. To satisfy their taste for the best, your water must be consistently as palatable as it is pure.

Best way to assure *consistent palatability* is by a program of daily threshold odor tests and controlled application of AQUA NUCHAR.

AQUA NUCHAR is the most effective way to eliminate taste-and-odor-forming substances from water supplies.

And it is economical, too. Because of its amazingly porous surface, extremely low average concentrations keep water clean and fresh-tasting at all times . . . at a cost of pennies per day.

Our trained field staff will be pleased to assist you in setting up a palatability program in your plant.

West Virginia Pulp and Paper

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WHY "STIR UP A STORM"

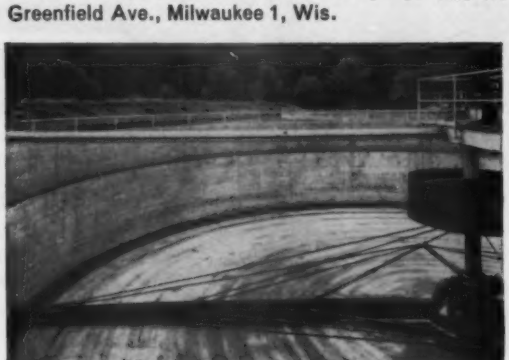
when you want uniform, rapid sludge removal

REX UNITUBE TOW-BRO provides positive, uniform, gentle and rapid sludge removal... with highest possible sludge concentration...*without a storm.*

Because it employs a *gentle suction action only* instead of the conventional plowing or combination plowing and suction action to withdraw sludge, Tow-Bro reduces agitation of the sludge to the absolute minimum. Results: higher solids concentrations... clearer effluent... less volume... most rapid withdrawal rates and maximum possible range of any mechanism. In addition, since sludge is withdrawn at a faster rate ...even with a light sludge blanket... you get greater settling tank capacity and greater operating flexibility. Construction costs are less, too, because no sludge hoppers or center pier is required and tank bottoms are essentially flat.

With Unitube Tow-Bro, a tapered, rectangular header arm revolves slowly around the tank and removes all sludge from the tank bottom in one revolution. Sludge is withdrawn through scientifically spaced and sized orifices in the arm by a gentle suction. Operating costs are reduced since minimum pumping is required to handle sludges of maximum density over the full operating range of withdrawals.

If you're looking for greater capacity... if you're having problems handling activated or trickling filter sludges, or other tricky sludges... investigate Rex Unitube Tow-Bro. For complete facts, send for your copy of Bulletin 315-81. Write CHAIN Belt Company, 610 W. Greenfield Ave., Milwaukee 1, Wis.



REX®

CHAIN BELT COMPANY

These RAS Blowers are in sewage treatment aeration service. They are rated 3000 CFM with discharge at 7.5 PSIG. RAS Blowers are suited to chemical processing, pneumatic conveying, metal working applications . . . wherever a blower is used.

Long periods of continuous operation? All round dependability? Oil-free air? Entrained liquid? Varying pressure? Limited installation space?

Roots RAS Blowers are built for demanding requirements. Rugged construction includes heavy stub-shafts bolted to segmental waist impellers, and conservatively rated pressure lubricated bearings.

RAS Blowers are gas tight, even for hot or light gases. Regardless of varying pressure they deliver a constant volume of oil-free air. Entrained liquids present no mechanical hazards.

Use RAS Blowers to solve your installation problems. Compact, completely enclosed construction not only saves space, it eliminates the need for a base-plate and provides full protection for outdoor installation. Side inlet and discharge connections simplify piping, too.

For maximum dependability—plus more CFM per dollar invested, select the optimum RAS Blower or RGS Gas Pump from 36 sizes, 1500 CFM to 35,000 CFM, with a unit for practically any service from 2 to 12 PSIG.

ROOTS-CONNERSVILLE BLOWER DIVISION • 900 W. MOUNT ST., CONNERSVILLE, INDIANA
In Canada—Roots-Connersville Blower (Canada), Ltd. • 212 King Street, West, Toronto

CLARK® *Engines, Compressors, Gas Turbines*

Working together in allied industries . . .

PODBIELNIAK *Centrifugal Contactors, Distillation Apparatus, Instrumentation*

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DRESSER INDUSTRIES INC.

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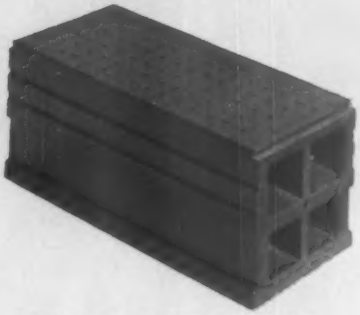
ELECTRONIC • INDUSTRIAL

Leopold....

ONE SOURCE, ONE RESPONSIBILITY

WATER PURIFICATION AND FILTER PLANT EQUIPMENT



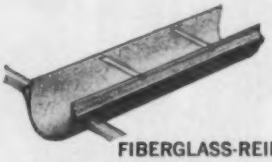
GLAZED TILE FILTER BOTTOMS

For more than forty years, Leopold has been serving municipalities with time-tested products, technical "know-how" and filter plant design experience. Now you can specify Leopold for the entire job, whether it be for rebuilding or adding plant capacity. Depend on Leopold's careful handling to produce an effectively engineered operation complete with dependable Leopold products, from "top to bottoms." Write for complete information on any of the products illustrated to the F. B. Leopold Company, Inc., 227 South Division Street, Zelienople, Pennsylvania.

Leopold also manufactures flash and vertical shaft paddle mixers, samplers and sampler tables, orifice box solution feeders and other accessories.

RUBBER-SEATED BUTTERFLY VALVES

FIBERGLASS HOPPERS AND SOLUTION CHAMBERS



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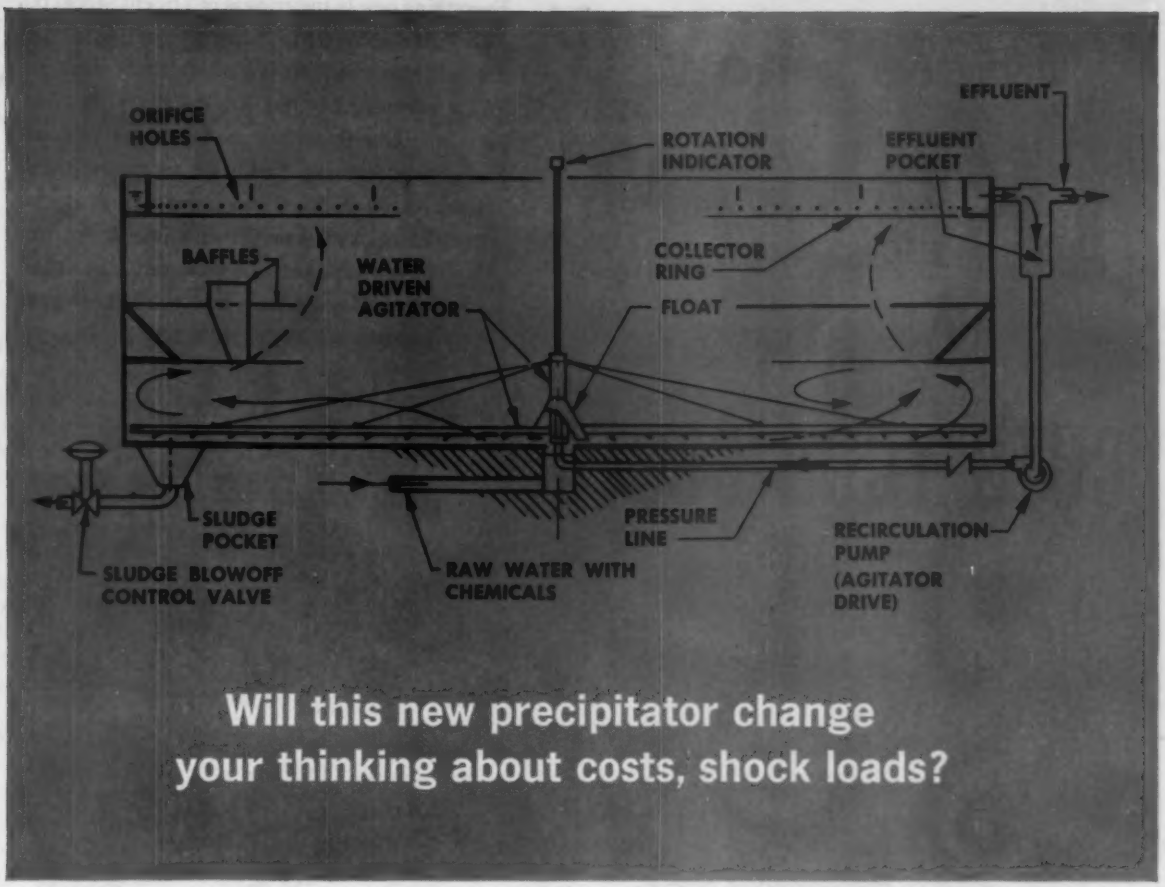

New Permutit Type M Precipitator ... a study in simplicity

Now in operation is this new precipitator for reducing turbidity and color in water.

We call it the Permutit Type M Precipitator. It is a study in simplicity, and because of its low construction and operating costs, it opens up new opportunities to obtain solids-contact clarification at minimum cost.

"Missing" parts: There is no motor-driven agitator on the Permutit Type M Precipitator. No extensive baffling. No center platform. No access walkway. All these have been done away with, because the unit has a new and different agitator system which sweeps away the settled sludge. Rotating agitator arms are supported by a "semi-buoyant" hub (or float) which revolves about a bearing post on the tank floor. Recycled effluent drives the agitator through jet nozzles located at the end of each arm. Smaller jets, spaced along the arms, gently nudge the settled sludge toward a sump at the outer rim of the tank floor.

Briefly, this is how the M unit works: raw water and chemicals are mixed in line and enter at the center of the tank floor beneath the conical rotor float which deflects the fluid mixture radially outward to the walls. A horizontal baffle on the tank wall then reverses the flow back toward the center thus imparting a rolling action to the sludge blanket. This current flow constantly places previously formed sludge in intimate mixture with the raw water immediately as it enters the tank. Clarified, effluent is collected by a flume at the top.

Agitator float and hub assembly.

Sudden water changes: An additional benefit of the Permutit Type M Precipitator is its exceptional ability to handle shock loads.

A case in point: red dye from a paper mill a mile upstream showed up one day in the raw water entering a Permutit Type M Precipitator in use in New England. But the unit went right on putting out an effluent with no significant change in quality.

So much interest has been shown in this new unit that we have reprinted the paper, "A Recent Development in Solids Contact Clarification Design", by E. D. Driscoll of Permutit. We'll be glad to send you a copy.

Write to Permutit Division, Dept. WS-91, 50 West 44th St., New York 36, New York. (In Canada, contact the Permutit Company of Canada, Toronto.)

PFAUDLER PERMUTIT INC.
Specialists in FLUIDICS ... the science of fluid processes

Here's how TRIDENT Model 60 CUTS YOUR COSTS

Everything new in metering is in Trident Model 60. This is the meter that protects your present and future investment. This is the meter that gives you all the advantages of modern, sealed construction, plus two most important money-saving features. Study these features. You'll see for yourself why Trident Model 60 offers impressive savings in your overall costs. And your system's investment (for which you are responsible) is protected . . . now and in the future. May we show it to you? Phone your Neptune representative, or write today.

1. It can be repaired, reset to zero and recalibrated in your own shop. No need to scrap half a meter just because a minor part is damaged.

2. Older Trident meters can be modernized. Both Model 60's sealed register and sealed gear train are interchangeable with present Trident parts. There's no obsolescence.

Non-fogging sealed register can be repaired, re-sealed, re-dehumidified. Replaceable crystal. Powerful shielded magnetic drive. Has sweep test hand. Wheels can be reset to zero . . . a boon to utilities who turn repaired meters back to zero for good public relations.

Change gears . . . exclusive among hermetically sealed meters . . . permit adjustment of registration. No need to lose income just because of a little wear or mineral deposits. No need to scrap expensive major components for lack of change gears.

Totally sealed gear train. Water never touches gears. No corrosion. No water or oil leaks. Sealed and lubricated for life. Powerful shielded magnetic drive.

Quiet Trident flat-disc measuring element. The finest, most wear-resistant and trouble-free principle. Remarkably sensitive to "leak type" low flows. Stays sensitive longer because it's precision machined to minimize effects of wear or deposits.

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Cooling Water for Air Conditioning — Part 1

Vol. 108, No. 9 • September 1961
WATER & SEWAGE WORKS
A Scranton Gillette Publication

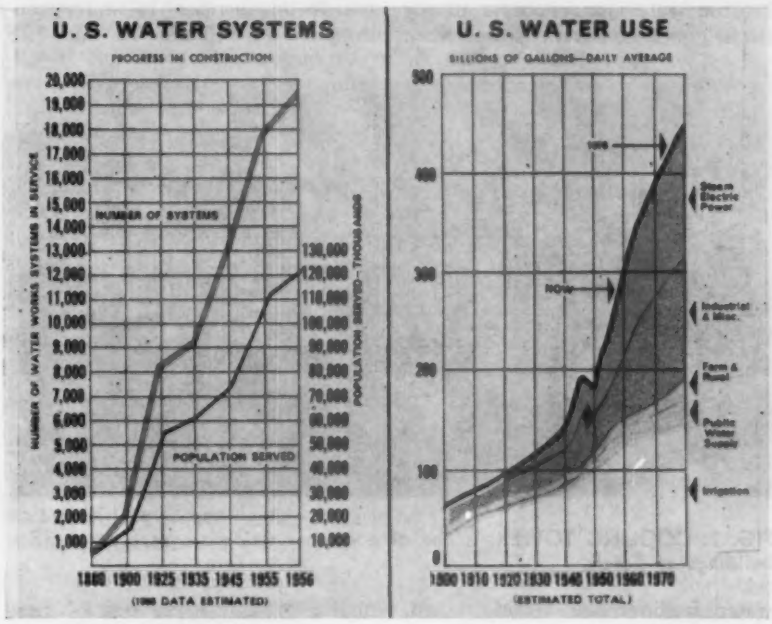
by HENRY F. MUNROE, San. Engr.,
B-I-F Industries, Inc.
Providence, R. I.

■ THE ACCEPTANCE of air conditioning as one of the conveniences of modern civilization is so widespread today that almost every commercial establishment is presently providing this convenience or is planning to do so. Statistics from the City of Chicago emphasize this acceptance. In that area the total tonnage of installed water cooled air conditioning units increased from 40,000 tons in 1936 to 296,000 in 1956; in 1960 the total tonnage exceeded 560,000 tons.

Water Requirements

Although some of the smaller units use air as the cooling medium, the vast majority of air conditioning systems use water. Two types of water cooling systems are used: (1) *Once-through* or non-conserving and (2) *recirculating* or water conservation type. The *once-through* system involves the passage of comparatively large volumes of low temperature water through a heat exchanger and then to waste or other use. The *recirculating* system utilizes evaporation as a means of cooling the water that has passed through heat exchangers and the water is used again. Only the loss due to evaporation must be added to the latter cooling system.

Air conditioning requirements are extremely seasonal (3 to 5 months a year) and *once-through* cooling systems often impose heavy burdens on both water supply and sewage treatment facilities. Since the present charges for water are so low (averaging approximately $0.16 per 1000 gal) and the air conditioning season so short, it is difficult for water and sewage utilities to derive sufficient revenue to cover even the annual fixed charges for the construction of larger facilities to serve these air conditioning demands. For this reason, most municipalities are trying to reduce or eliminate the *once-through* installations.



Courtesy of Mueller Co.

FIG. 1. WATER CONSUMPTION and water supply systems in the U. S. will increase.

The water producing facilities of our nation are already faced with a need for tremendous expansion, even without air conditioning. The expected required expansion is indicated by the curves in Figure 1. Note that an anticipated increase in water usage of 73 percent is expected in the next 20 years. Water usage will then reach a high of 420 bgd (billion gallons per day) of which industry will probably use 120 bgd.

A leading authority has estimated industry's water usage to be distributed as follows:

Use	Percent of Total
Cooling	53
Process	31
Boiler feed	8
Sanitary purposes	5
Miscellaneous use	3

Of the amounts used for cooling, it has been estimated that steam con-

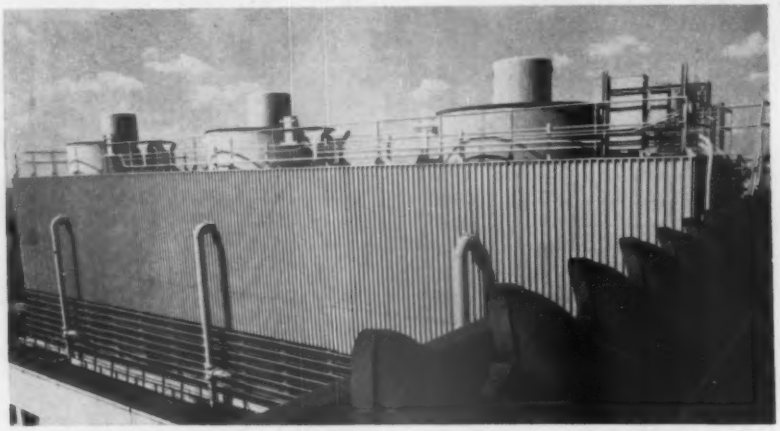
The demand for human comfort through air conditioning has, in many places, burdened water supply and waste treatment facilities.

This series of three articles is presented to give readers an appreciation of problems surrounding the use of cooling water in air conditioning. The subject is outlined for presentation as follows:

Part 1—Water for cooling.
Part 2—Water treatment requirements.
Part 3—Instrumentation and control of water quality.

densers require 5 to 12 gal per ton of steam condensed, refrigeration uses 2 to 5 gpm per ton of refrigeration and diesel plants use 0.2 to 0.6 gpm per hp.

The water requirements for air conditioning approximate the values given for refrigeration, but the refrigeration demand is much more uniform than the air conditioning demand. Due to seasonal operation, the demand for air conditioning cooling water imposes a peak upon a peak because water usage occurs during the height of the summer season when water facilities are already taxed, often to their utmost. Alex C. Burr of the North Dakota Research Foundation estimates the water requirements for air conditioning to be 6,000 to 15,000 gal per cap per season.



Courtesy J. F. Prichard & Co.

FIG. 2. COOLING TOWER, is one of a number which are seen atop office buildings or hotels.

Water Surcharges

In order to provide funds to accommodate water needs for air conditioning service, several public service commissions have allowed water facilities to make a surcharge to those consumers having water-cooled air conditioning devices of a non-conserving type. These charges are made in addition to the cost of the water. Some examples are:

City	Cost per ton/yr.
Omaha, Neb	$36.00
St. Louis County	40.00
Detroit, Mich.	7.50
Appleton Co., Wis.	20.00
Pine Bluff, Ark.	12.50

Demand rate charges for cooling water usually make it desirable to install recirculating systems as a means of avoiding high costs for water. Cooling towers cost from $70 to $120 per ton of refrigeration, depending on the size and type of the unit.

The following case history is an example of the savings which may be made by using recirculating systems. A large Chicago hotel expanded its air conditioning system to accommodate 1700 rooms which increased the total refrigeration requirements from 1765 to 2500 tons per min. This load would have required an increase in water consumption of between 1.5 and 1.75 mgd or a daily water cost of more than $200. The old *once-through* installation was replaced with a new system which provided water conservation through recirculation. The hotel's chief engineer reported, "Since it went into operation, our records indicate that our water expenses for air conditioning are approximately 4 percent of what they would have been under the old system. Based on a present rate of saving on water costs, we feel that the tower will have paid for itself within the next 5 years." According to the ASHVE report, the probable useful life of a cooling tower is 15 years; on this basis a saving of better than $100 a day is indicated.

Recirculating Cooling Systems

Because of the increasing cost of water plus the demand rate charges for air conditioning of the non-conserving type, it appears that substantial savings can be realized by the installation of recirculating systems which re-use cooling water. Cooling water recirculating systems may utilize one of three different types of equipment: (1) the cooling tower, (2) the evaporative condenser, or (3) the spray pond. All of these systems work on the principle of evaporating a portion of the warm recirculated water in order to reduce the temperature of the remaining volume. The cooled water is then returned to the inlet of the heat exchanger. Because of the very nature of this system, the water problems encountered are critical. Some of the methods of water treatment will be discussed but it is recommended that investigations of particular water problems be turned over to organizations specializing in this type of work.

In the cooling tower (illustrated in Figure 2), the warm water from the heat exchanger is pumped to the top of the tower and conducted through a series of distribution troughs. The water falls from these troughs through a series of baffle and splash plates which break the sheet into very small droplets; these droplets provide a greater exposed water surface area. A supply of relatively dry counter-current air coming in contact with these droplets evaporates a portion of the water thus reducing the temperature of the remaining volume. This system requires only sufficient pump pressure to force the water to the top of the tower and through the distribution channels or spray nozzles. For maximum efficiency, the water must be evenly distributed throughout the cooling tower area and must be exposed to as large a surface as possible. The tower should be able to pass a large volume of relatively dry air over these surface areas.

There are three systems for providing the evaporative air to cooling towers. They are: natural draft, induced draft, and forced draft. The natural draft system relies on the natural movement of the air through the tower. In the induced draft system, air is pulled through by a series of fans at the top; in the forced draft system, air is pushed through by fans at the bottom.

Evaporative condensers are used for smaller air-conditioning installations. These condensers are actually cooling towers within which the heat exchanger is also incorporated. In

these compact units (Fig. 3) the refrigerant is piped and cooled by evaporative effect of water sprayed over the pipes. This sprayed water is re-circulated within the condenser while an induced draft system pulls air through the unit. This system involves direct contact of cool water with piped refrigerant and includes exposure of minute droplets to a counter-current of dry air.

The spray pond is the oldest type of cooling system. The warm water entering the pond is discharged upward under pressure from a series of spray nozzles located near the pond surface. When compared to the modern cooling tower, the spray pond is a very inefficient cooling system. This is because water must be delivered to the nozzles at a comparatively high pressure in order to force a given volume of water upward into the cooling atmosphere. Since the downward path of the droplets is short, temperature reduction is much lower. In addition, the pond area required to provide a surface exposure equivalent to cooling towers is much greater and wind drift losses of water are much higher.

Cooling Towers

Since most modern systems use the cooling tower type of recirculating system, a general discussion of various aspects of cooling tower design and operation seems warranted. To do this, it will be necessary to explain the units of measurement and methods of rating cooling capacities.

Air conditioning and other cooling systems are rated according to their refrigeration capacities; the standard unit of refrigeration being tons of ice per day. Since it is necessary to remove 143 Btu to change 1 lb of water at 32 F to 1 lb of ice at 32 F, a ton of refrigeration per day will require [(2,000) (143) ÷ 1440] or theoretically 200 Btu per min to be removed. In addition another 50 Btu per min is required to remove the heat resulting from the work done in the refrigerating compressor to make an equivalent ton of ice. This gives a total of 250 Btu per min to be removed to provide 1 ton of refrigeration. Another unit for expressing cooling effect of towers is the standard value that for a 10 degree difference in water temperature, it is necessary to evaporate about 1 percent (.75 to 1.25 percent) of the water circulated.

Recirculating cooling systems require a certain amount of make-up water. There is a continuous loss of water in cooling tower systems consisting of (1) the evaporation loss (2) windage loss, and (3) blowdown to prevent dissolved solids buildup. The evaporation loss provides the cooling effect and constitutes a loss of water only and not of chemicals. It is important that this concentrating process not be allowed to exceed the limiting value set by the least soluble chemical (usually calcium carbonate). The windage loss (both water and chemical) varies with the design of the tower, its type and location. Most authorities use the following figures to compensate for windage loss:

Cooling Method	Percent of the Re-circulating Rate
Atmospheric Towers	0.3 to 1
Mechanical Draft Towers	0.1 to 0.3
Spray Ponds	1 to 5

As a result of evaporation and resulting concentration of solids in cooling water, it is necessary to remove or blowdown a portion of the remaining water. This blowdown is replaced by a water having a much lower solids concentration.

Courtesy of Brush Mfg. Co., Hartford, Conn.

FIG. 3. EVAPORATIVE CONDENSERS provide cooling for refrigerants of small capacity air conditioning units.

In the initial treatment of a cooling water, much consideration is given to limiting the concentration of the various constituents to prevent scale forming. If the total solids remaining in the water after blowdown (and other losses) is to remain constant in order to avoid precipitation or scale formation, then the total solids coming into the system must be equal to the total solids discharged. Therefore the bleed-off or blowdown rate will be equal to the evaporation rate divided by the permissible concentration minus 1. The permissible concentration is obtained from the Langelier Index or similar formulas and varies with each water.

For dependable results, the maximum permissible solids concentration should be determined for each water. A rule of thumb based on average conditions suggests a permissible concentration of 2.5 times the original content. This gives a bleed-off or blowdown rate of 0.67 percent of the evaporation rate. This value is only a rule of thumb based on average conditions and should not be used indiscriminantly, however.

Adding the three losses mentioned above, the total normal loss (i.e., make up water) is obtained as follows:

Losses	Percent of Re-circulating Rate
Evaporation loss	1 per 10 F temp. diff.
Drift loss	0.1 to 5.0
Blowdown loss	0.67
Total make-up	1.8 to 6.0

Recirculation values between 3 and 5 gpm per ton of refrigeration are generally used; however, the actual recirculation rate for each particular installation must be determined from the cooling load.

Process Design

While many of the problems encountered with cooling water are of chemical nature, the mechanical design of a system has a very definite effect on the type of water problems encountered. For example, piping and fittings of the system should be of the same or of similar metals. The use of dissimilar metals should be avoided to eliminate electrolysis. If such is impossible, the dissimilar metals should be insulated through the use of plastic pipe, or the like.

Good engineering practice dictates that piping should be sized to maintain a velocity throughout the system of 3 to 5 fps (feet per second). Velocities below 3 fps result in higher costs for piping and piping that becomes plaqued by a deposition of solids plus a possible formation of slime and algae growths. Velocities above 5 fps present difficulties in maintaining protective coatings

and require increased pumping costs. Pump suction piping should be large enough to provide the design flow at pressures above 13 inches of Hg vacuum or as it is sometimes stated, the maximum total dynamic suction lift should not exceed 15 ft. This lift not only includes the actual elevation but the friction losses through the fittings as well.

In the design of piping, special consideration should be given to the location of the blowdown line. It may be located in the warm water return line to the tower where it will provide blowdown only when the recirculating pump is in operation and therefore reduce cooling load to the tower. Or, it may be located in the bottom of the cooling tower basin where it may assist the flushing of deposited solids out of the tower. The ultimate location will be governed largely by local conditions.

Cooling towers usually are constructed of the very best grade of red wood. Wood materials are, however, subject to attack from high chlorine residuals and subject to delignification from high carbonate and alkaline concentrations. For these reasons, some of the newer towers are being constructed with plastic packing to eliminate these difficulties.

Makeup water is usually added to cooling water at the basin before it is sent to a condenser or heat exchanger where its sensible heat is increased some 10 to 30 F. At this point, dissolved compounds, whose solubility is affected by increases in temperature, have a tendency to precipitate directly from solution onto the heat transfer surfaces. Chemical treatment is required to prevent this precipitation. The warm wetted surfaces in the heat exchanger also provide optimum conditions for the growth of thermophillic slimes that release CO_2 and O_2. The growth of slimes and other biological activity must also be controlled. From the heat exchanger or condenser, the water is transferred to a cooling tower. As the water is exposed to air to reduce its temperature, it absorbs CO_2 and O_2 to satisfy the increased solubilities at this lower temperature. From the cooling tower the water passes to the basin from where it will be pumped to the heat exchanger, completing the cycle.

Now that the mechanics and process operation are understood, it is obvious that cooling water itself could materially affect the efficiency of an air conditioning system if not properly treated. Effective treatment of cooling water must include the preventing of scale formation in heat exchangers, corrosion, and slime control in other parts of the cooling system.

Part 2 on Water Treatment Methods will be published in the next issue.

Indiana's Largest Sanitary Sewer Project

Believed to be the largest individual sewer contract ever awarded in the state of Indiana, the Ben Davis Conservancy District sanitary sewer project has recently been completed. The job took 720 days and was finished ahead of schedule.

The district, an unincorporated area of approximately 1,820 acres, is located immediately west of the city limits of Indianapolis and extends approximately three miles along U. S. Highway 40.

Prior to construction of a sanitary sewer system, it was served by private septic systems which did not function well and presented a contamination problem. The area is highly developed in spots but included open areas suitable for new residences, business firms and industrial development.

Cost of the project was $3,300,000. It included three divisions as follows:

Division I—Furnishing and installing a complete sanitary sewer system comprising approximately 75 miles of sewer pipe to service each residence, vacant lot and business building within the boundaries of the district.

Division II—Construction of a pumping station building and wet well 148 by 18 by 25 ft., including all equipment and controls.

Division III—Construction of two relief sewers complete with all appurtenances.

(Wastes will be pumped into the City of Indianapolis sewer system.)

The job culminates several years of effort by the officers of the Ben Davis Conservancy District and the "West 40 Club"—a community promotional group. General obligation bonds were approved for the project and the job was bid in 1953, but legality of the Conservancy District Act was questioned in the courts. This was subsequently cleared up and the job was started in 1958.

J. B. Wilson & Associates of Indianapolis served as consulting engineers. E. A. Harrold Construction Company of Wayne, Michigan, was the contractor.

Vitrified clay pipe with compression joints was used for house service connections and all mains up to including 24 in. Reinforced concrete pipe was used for large sizes (27 in. and over).

Trench depths on the job ranged from 6 ft minimum to 24 ft maximum. Trench widths ran from 24 in. for house service and from 30 in. to 5 ft for mains.

Giant Prestressed Concrete Reservoir

A prestressed reservoir under contract with The Preload Co., Inc., New York, to be built at Alderwood Manor, Snohomish County, Washington, will have nearly twice the capacity of the present largest prestressed reservoir: 28,000,000 gallons.

The reservoir will be 370 ft in diameter with 27 ft-6 in. high walls and a "dished" bottom which will hold 25 percent of the tank's capacity. It will be unroofed and cost nearly $600,000.

The tank will be prestressed with multiple layers of wire, applied under tension by a self-propelled machine suspended from the top of the wall.

Consulting engineers are Gray & Osborne, Seattle & Yakima, Wash.

CONSTRUCTION

The Monocacy River Filtration Plant

by E. E. HALMOS, JR.

■ PUSHING TO MEET a water supply situation where present facilities are just about able to meet existing demand, the small City of Frederick, Maryland hopes to have its new 2 mgd water filtration plant on the Monocacy River in operation by midsummer of 1961.

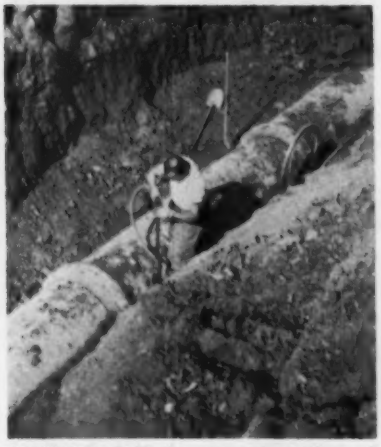
The plant, designed for considerable expansion in treatment and pumping capacity as future demand may require, will have no storage reservoir on site. Finished water will be pumped directly from the clearwell into supply lines for distribution and storage in the City's two 1 mil gal elevated tanks.

Frederick, county seat of a prosperous dairy farm county and with a number of small industries of its own, is far enough out of the orbit of its two big-city neighbors, Washington and Baltimore, that its growth has been steady and slow, rather than explosive. Biggest factor in its growth has been the establishment on its outskirts of Fort Detrick, an Army Chemical Corps installation. This post, which has its own water supply system, has brought an estimated 3,000 workers, many of them with families, to the community, and many of these have taken residence in the city.

To serve its present estimated population of about 22,000 persons, the City utilizes one filtration plant with a capacity of about 3 mgd, located on Linganore Creek, a Monocacy River tributary, and a 77 mil gal reservoir in the mountains to the west which can feed some 2 mgd into supply lines. Peak demand during the past summer reached 4.67 mgd; normal summer demand is about 3 mgd, and City officials had become concerned that the supply was too close to immediate demand for comfort. There is an emergency supply available, if needed, from Fort Detrick's own plant, both City and Army have interchanged supplies on an emergency basis in time of need.

In addition to the new filtration plant, the water department has embarked on a program of new force-main construction that will eventually completely encircle the City limits to get better distribution. One of the two 1 mil gal standpipes, just completed, is a part of this program.

Located northeast of the City proper, the new filtration plant is the first municipal tap on the Monocacy River, whose principal claim to fame is that it meanders back and forth across areas that were major battlefields during the Civil War.



TRENCH CUT for 30 in. reinforced concrete intake pipe will be backfilled after machine tamping. Alluvial character of soil is visible in banks which made for relatively easy excavation.

Design

From a design and construction viewpoint, the plant is a relatively straightforward proposition, lending itself to an almost simultaneous development scheme.

From an intake on the river bank, water is brought by gravity through a 30 in. reinforced concrete pipeline for a distance of 450 ft, to the foot of a raw water pumping station. Lifted 40 ft and sent through a 24 in. concrete force main, in a somewhat unusual arrangement, the water is brought to the headhouse for initial chemical dosage, then to a flocculation and sedimentation basin for mechanical treatment.

From this basin, it will be pumped to the headhouse filters and clearwell, (capacity about 150,000 gallons), which will also serve as the on-site reservoir, then pumped into City lines.

Enough area is included in the site to provide space for four additional sedimentation basins if this additional capacity should be required.

There are also provisions for connecting another intake if any of several proposals for storage dams on the river are ever implemented.

Construction

Taking advantage of this straight-line plan and the relatively small distances involved, the contractor, Eager Stone & Construction Co. of Baltimore, started various projects of the job almost simultaneously. Distance from the river intake to the outer, (west), wall of the headhouse is about 850 ft.

Although the area is relatively small, quantities are considerable. The whole job, including drainage, access roadways and structure (not pipe-trench excavation), will involve some 8,000 cu yd of earthmoving, about 600 cu yd of rock excavation, and about 1,800 cu yd of concrete placement.

The composition of the earth in the area lent itself to rapid operations with comparatively little heavy equipment. Almost half of the site is located in the old flood-plain of the river, and soil borings show an overlay of topsoil, brown clay, and

PATENTED PLYWOOD-FACED forms and shoring are used throughout construction, even in intricate forming such as this for pumping station roof.

FLOCCULATION and sedimentation basin walls are 13 ft, 6 in. in height, with standard form sections used for forming.

broken and heavily seamed blue and brown limestone. Most of this material, with the exception of the aforementioned 600 cu yd of rock work, could be moved with small shovels, front-end loaders and rippers.

For the structures themselves, Eager Stone has gone completely over to the use of patented form panels, even for some of the intricate forming required around pipe adits, gullets and sleeves in the headhouse intakes, and in other areas.

In addition, he has used specially built adjustable shores to support panel formwork used to cast beams that will carry a heavy headhouse floor as much as 20 ft above the bottom of the clearwell and filter areas.

Use of the panels, according to Jerome L. Falk, project manager, has made for fast erection and stripping, and the various sizes available give ample flexibility. Of particular interest is a smooth finish on both sides of the resulting walls, requiring little rubbing or other treatment for final finish. Since the buildings will not be given any outside treatment on completion, appearance is a major factor.

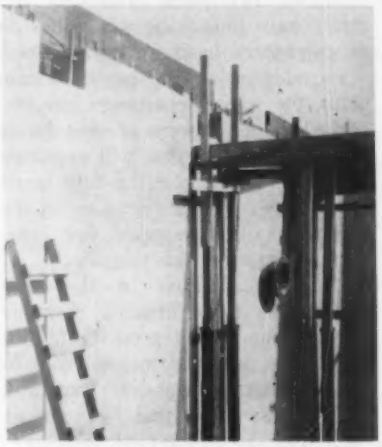
Details

The river intake structure actually set back from the bank by a distance of about 33 ft. A 10 ft wide channel leading to the intake, inclined to the south in accordance with the direction of stream flow, is protected by rows of steel sheet piling. This serves to protect the intake structure during construction and will be left in place after treatment with a mastic to protect the banks of the intake channel when the plant is in operation. The sheets are about 22 ft long as finally cut off, driven roughly 12 ft below the river bed to firm rock footing.

The intake structure itself is 14 ft long, overall, 12 ft high above the 2 ft thick reinforced concrete slab, and 10 ft wide. It will include provisions for stoplogs; an inclined bar screen 10 ft, 4 in. long to protect against major floating debris.

Incoming water will feed by gravity, a drop of about 2 ft in the 450 ft length of intake pipe, to the base of the raw water pumping station.

This pumping station, of reinforced concrete construction, is 30 ft, 4 in. long, (north-south), and 16 ft wide at ground level, 40 ft deep. Above at ground level, it will carry a 9 ft high house of concrete block con-



INTERIOR WALL of headhouse clearwell basin shows smooth finish of concrete after forms are stripped. Shores at center right are 20 ft in height and support formwork for beam that will be 24 in. wide, 1 ft thick, to support upper floor of headhouse.

struction, to provide access to pumps and other equipment. Initial installation of pumping equipment will be one 700 gpm and one 1400 gpm Worthington pump. Space is provided both for the addition of another pump and for larger pumps.

From the pumping station, the water will travel about 250 ft further through a 24 in. concrete force main, running through a horseshoe pipe arrangement in the headhouse, (with adits for dosage principally of alum and lime), then emptying into the one initial flocculation and sedimentation basin.

This basin, a duplicate of any others that may be added in the future, is 122 ft, 6 in. long, 47 ft wide, with outer 12 in. thick reinforced concrete walls 13 ft 3 in. in height. The 12 in. thick floor slab pitches on a 1 in 12 slope to the center, which will be the base for mechanical cleaning equipment, and location of the outflows. Capacity will be about 560,000 gallons.

From the basin, the partially treated water will move again to the 78 ft 5 in. long, 45 ft, 3 in. wide, 48 ft high headhouse for filtration and storage until pumped into the mains. Initial headhouse pump installation will consist of a 60 and a 100 hp pump.

The flocculation basin is built at ground level, the headhouse partially in an excavation so its three actual stories will appear as only one story 20 ft above the ground level when completed. In addition to pumping and chemical equipment, the headhouse will contain offices for the City water department employees.

The plant has been designed for almost completely automatic operation and will require no more than two men on duty at any normal operating period.

Acknowledgments

The Monocacy Filtration Plant is being built for the City of Frederick for whom Robert A. Whiteford is City Engineer and William Davis, Water Superintendent.

Consulting engineers are Whitman, Requardt & Associates of Baltimore.

GULLETS such as this one will carry water from flocculation-sedimentation basin to filters, required tricky formwork. In washing operations, flow of water can be reversed, so it will well up into gullets, flow out through sleeve for flushing.

Water Utility Distribution Loss

Part 2

by DALE SMELSER
Knoxville, Tennessee

EDITOR'S NOTE: This series on water quantity accounting outlines the problem, discusses the utility system generally and the utility distribution system specifically. Predicated on complete metering and systematized accounting, the method is adaptable to machine accounting procedures. Staggering national distribution system loss, estimated at $50 million per year for operating costs alone, is well worth studying and correcting.

■ THE LOGICAL PLACE to start a Loss Control Program is where the finished water enters the distribution system. Most, if not all, water systems measure this water with a meter; hence, the accuracy of the meter or meters is of prime importance. Inaccuracy of this measurement leads to a false accounting of loss, which will misdirect and confuse efforts at control. Under registration of the master meter will indicate less loss than is actually occurring, and over registration will erroneously indicate waste, which can lead to unnecessary survey expense. The metering device should be selected with careful regard for accuracy over the entire flow range. After installation a meter should be regularly checked at a frequency determined by experience to ascertain its accuracy. When installing a meter the manufacturer's instructions should be implicitly followed. This can and will save much future trouble.

No fluid meter is perfect, and the possible commercial accuracy varies with different type meters from an error of a fraction of one per cent to several per cent. The probability of sustained accuracy is important and meters with many parts subjected to mechanical wear are likely to lose accuracy over a long period of operation sooner than those with fewer parts. Accuracy may be expected to vary with the complexity of the system as to transmission methods. The accuracy obtainable from a secondary device is usually within 0.5 per cent at full flow, 0.75 per cent at three-quarter flow, and 1.0 per cent down to one-quarter flow. This emphasizes the necessity for meters to be properly sized for the service in which they are to be used. Where two meters may be required for the day load, the night load can probably be handled by one meter. It will insure better accuracy if the one meter is valved off during the night.

Table 3

Comparison of Differential Head Type Primary Elements[a]

Property	Concentric Orifice	Venturi	Nozzle
Accuracy	Excellent	Excellent	Good
Cost	Excellent	Poor	Fair
Pressure Loss	Poor	Good	Poor
Suitability for Solids in Suspension	Poor	Good	Fair
Range Changing Ease	Excellent	Poor	Poor
Capacity for a Given Line Size	Good	Excellent	Excellent
Length of Straight Pipe Required	Poor	Excellent	Excellent

[a]From H. O. HITE, "Primary Devices and Meters for Water Flow Measurement," Water and Sewage Works, 1955, R-68.

The primary element of meters commonly used in water plants are the Venturi tube, Flow nozzle, and the Orifice plate. A comparison of these is presented in Table 3. This study will consider the Venturi tube.

> "The Venturi tube combines a single element a short constricted portion between two tapered sections and is usually inserted between two flanges in a pipe. Its purpose is to accelerate the fluid and temporarily lower its static pressure. Suitable pressure connections are provided for observing the difference in pressures between the inlet and the constricted portion or throat. The proportions of the venturi tubes for metering liquids are usually substantially the same as those originally adopted in 1887 by its inventor, Clemens Herschel."[6]

The Venturi tube is a reliable device for measuring the flow of water through a pipe line. Tests should be periodically made to determine the accuracy of the tube and the recording, indicating and totalizing devices. The procedure for testing a specific meter can always be obtained from the manufacturer and such information should be in the files of every water plant.

Knoxville Plant Meters

At the Knoxville, Tenn., plant the Venturi tube on low lift pump No. 1 and high lift pump No. 1 had been in service over thirty years. The tubes are 30-inch inlet and 21-inch throat. An inspection revealed an

accumulation of incrustation to a considerable degree, especially in the low lift tube. The entrance diameter was reduced to twenty-six inches at one point and the average accumulation through the tube was about one-half inch which reduced the nominal diameter one inch. The tube on the high lift pump was found to have a piece of pump casing about three to four inches in size lodged near the throat. The author made computations to determine the effect on the accuracy of the tube and meter, and the following estimate is conservative:

Low lift Pump No. 1 registered 100 mgd, should be 106 mgd, or six per cent.

High lift Pump No. 1 registered 100 mgd, should be 103 mgd, or three per cent.

The average high lift pumpage at this plant is about 19 mgd, therefore, the high lift meter was registering 570,000 gallons per day less than the actual amount flowing through the tube. Such a situation certainly distorts the records and makes it difficult to obtain a true picture of the actual operating conditions. Further, the success of a loss control program is predicated upon knowing the quantity of water entering the system; therefore, the plant meters must function properly.

Power Used for Pumping

A study of the electric power used for high lift pumping resulted in the development of a method by the author for making a general check on the high lift meter accuracy, by checking the power used in pumping the water. A power requirement formula may be written as follows:

$$\text{Power requirement (factor)} = \frac{\text{Kwhr}}{\text{HL} \times \text{Q}}$$

Kwhr = Kilowatt hours
HL = Hydraulic head, by pump
Q = Discharge, Million gals.

The following computation is made from the operating data of the Knoxville, Tenn., plant for the month of Jan., 1959. The application of the above formula will produce a power requirement factor (Pr). The water to wire efficiency was 78.5 per cent.

$$\text{Pr} = \frac{788{,}000}{324 \times 608} = 4.00$$

The intended use of the factor in this study is to compute the high lift pumpage from power used to compare with the high lift meter registration. For example, the Knoxville pumpage as shown by computation for Jan., 1959, is as follows:

$$\frac{\text{Kwhr}}{\text{HL}} \times \frac{1}{\text{Pr}} = \frac{788{,}000}{324} \times \frac{1}{4} = 608 \text{ mg.}$$

Note: The meter registration was the same—608 mg.

The unaccounted for water is to some extent proportional to the difference between the water pumped as shown by the meter and that calculated by the application of the power requirement formula. The first five months of the 1959 operating data at Knoxville were selected to test the formula and the results were as follows:

		Jan.	Feb.	March	April	May
Computed by Power used	(mg.)	608	528	558	575	668
Actual by meter	(mg.)	608	501	531	539	665
Difference	(mg.)	0	27	27	36	3
Difference	(Per cent)	0	5.1	4.8	6.3	0.45

The percentage of unaccounted for water based on the plant meter registration is abnormally low during the months of Feb., March and April of 1959. (See Figure 5). As mentioned previously, the meter register-

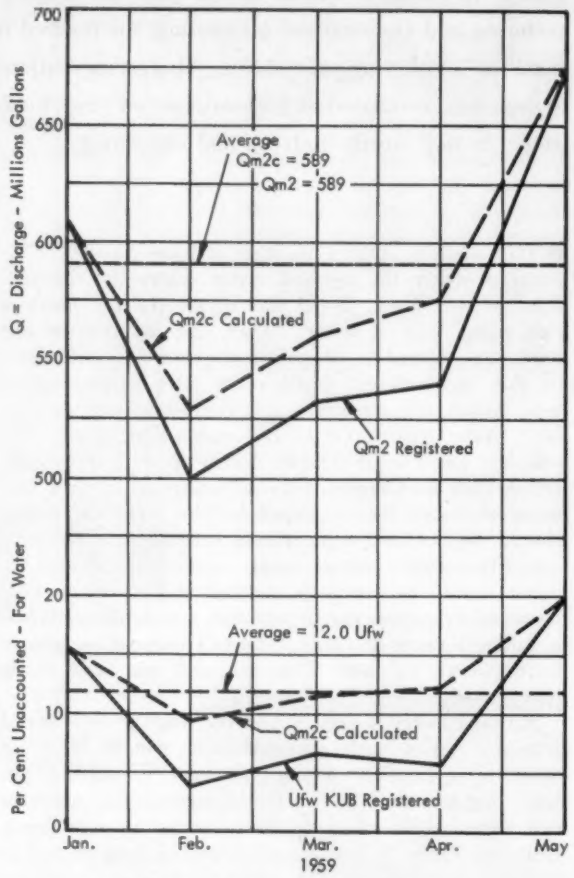


Fig. 5. COMPARISON OF DISTRIBUTION system input metered (Qm2) and calculated (Qm2c) with variation in unaccounted-for water percentages.

ing the pumpage to the system was found to be out of order and the primary element needed cleaning. These conditions were corrected during March and April, and the reported percentage of unaccounted for water increased to a reasonable figure, as denoted on the graph for May. Figure 5 shows graphically the effect of meter inaccuracy in the reported unaccounted for water. The upper curve indicates the quantity of water passing through the plant meter as registered and that calculated by the power requirement formula. The lower curve shows the percentage of unaccounted for water resulting from the registered and the calcu-

lated quantity. The use of this method will serve to detect any significant variations in the losses occuring in the system so that corrective measures can be more promptly applied.

Water Losses in the Distribution Center

Each gallon of water flowing into a distribution system that does not arrive at a point to be registered on a customer meter is an unmetered sale and is a loss to the utility. A system with a high percentage of unaccounted for water should undertake a survey to locate and correct leaks and other sources of loss. This can be accomplished by any water operation regardless of size, and the results may prove surprising, especially if no such survey has been made for several years. A good start can be made by using a listening device on every valve, hydrant, and service.

It has been proved many times that a properly conducted program to reduce leaks is profitable. The city of Dallas, Texas, has kept good records on leaks. It was estimated that the leaks found and repaired over a five-year period, if allowed to continue for five years, would cost the city $83,882.00 for power and chemicals. The average estimated leakage found each year was 882 million gallons or 2.8 per cent of the annual primary pumpage. This was accomplished with a total outlay for wages of $21,291.00 over the five-year period.

The well managed water system embarking upon a loss control program will set up records as an aid to determine the extent of the loss and the portion of such loss that may be feasibly corrected. The maintenance of the records is a continuing process and should be as simple as possible to attain the objective sought. The first step is to establish the unavoidable loss in the system under study. This figure should consider the age of the system, the pressure, and other factors as mentioned before. Leakage is almost certain to increase as a system becomes older.

Unavoidable Losses

Much has been written on the subject, and several methods have been developed for estimating the unavoidable loss in the water distributing system. The following by Emil Kuichling is uniquely descriptive of the origin of leaks in the average system:

> "A discharge of one drop per second from each joint, five drops from each hydrant and stop valve, and three drops from each service pipe, including tap and unit cock, represents a fair measure of the average undiscoverable leakage in a well constructed distributing system . . . . On this basis and with the assumption that on the average there are 504 pipe joints, 12 hydrants, 10 stop valves and 100 service pipes per mile of distribution pipe, leakage will amount to 2,742 gpd per mile, or in round figures, from 2,500 to 3,000 gpd per mile.[7]

The unavoidable losses are those that would cost more to locate and repair than to permit to exist. The determination by estimate of the unavoidable losses is a requisite for a loss control program. Each item mentioned should be studied and an estimate made for the specific system. The base figure can be revised as substantial additions are made. After the record is established it can be maintained with a minimum of effort. It is obvious that no yardstick or formula is applicable to all systems, because of a different set of conditions prevailing in practically every operation. Estimates have been made that for an average distribution system the incorrectable losses may be divided with one part to distribution piping and two parts to service piping.

In Great Britain after extensive waste water survey experience with night metering it was concluded that unavoidable losses may vary from 3 gpcd for a new system to 10 gpcd for an old system.[8]

The actual experience of the Knoxville system serving a population of 170,000 during 1958, expressed as averages, is as follows:

Production, gallons per capita per day	gpcd Di =	112
Sales, gallons per capita per day	gpcd Ds =	96
Loss, gallons per capita per day	gpcd DL =	16
Percentage sold, of distribution input	%Ds =	85
Percentage loss, of distribution input	%DL =	15
Loss per service per day, gallons	DL/sd =	68
Loss per mile of main, gallons	DL/mm =	4300
Minimum night (hour) demand	gpcd MND =	59

Ratio minimum night flow to average day demand

$$R = \frac{MND}{ADD} = 0.5$$

Knoxville has 633 miles of mains with an average of 65 services per mile. About 3,000 hydrants are in the system. The 502 accounts served by two-inch or larger meters accounted for 57 per cent of the total sales, eight per cent of which was through two ten-inch meters. The total number of meters in the system as of Dec., 1958, was 41,023. Therefore, 12.2 per cent of the metered consumers used 57 per cent of the water sold. In general, as the industrial and commercial load on a given system increases, the unavoidable leakage will decrease because of the lesser number of services required.

The practice of expressing losses in gallons per capita seems to have certain advantages over the percentage method; however, in view of the variables encountered in every system no single method can be successfully applied without some deviation to meet specific conditions.

New Construction

Some leaks can be stopped before they start by giving close attention to the installation of new mains. In recent years the great haste in providing service to hurriedly constructed sub-divisions and other installations has no doubt caused the neglect of proper initial testing. When a new pipe line is installed it should definitely be tested before backfilling the trench, and in accordance with the standards as contained in section 13.7 AWWA C 600-54T. The formula for allowable leakage is as follows:

$$L = \frac{N D P}{1850}$$

L = allowable leakage in gallons per hour.
N = number of joints in the length of pipe line tested.
D = nominal diameter of the pipe in inches.
P = average test pressure during the leakage test in psi. gage.

A water utility engaged in substantial additions to the system can by keeping records of all tests accumulate valuable data regarding unavoidable loss. Much can be achieved toward loss prevention by installing water mains in accordance with the AWWA standard specifications. When a cast iron main with bell and spigot joints is installed under a railroad or heavily traveled highway clamps should be provided at each joint to prevent future joint failures. It is well known that many pipe breaks causing loss of large quantities of water can be traced to faulty installation.

A survey of 2,034 miles of mains located in 18 cities showed 46 per cent of all breaks were caused from faulty construction or interference by other underground construction.

Some very extensive studies on pipe failures in Indianapolis, Ind., showed that joint failures occurred predominately in the large mains and pipe breaks were more numerous in the smaller sizes. Failures were primarily prevalent when water temperatures were reaching maximum variations. Possibly the most common fault found in new construction is improper bedding and backfilling, which will certainly impose strains that will ultimately cause leaks or breaks.

When a service is installed from the main to the meter, water should be applied to test the joints before the trench is backfilled. Good construction today will return excellent dividends tomorrow.

References

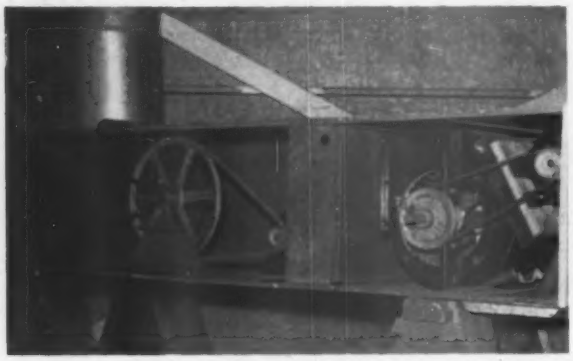
6. Herschel, C., "The Venturi Water Meter," Transactions of American Society of Civil Engineers, 17:228 (1887).
7. Kuichling, Emil, "Venturi Tube," TASCE, 38 (1897).
8. Whitteron, B., "Losses in Mains and Water Unaccounted-for," Journal, Institution of Water Engineers, London, 1:557 (1947).
9. Dolson, F. E., "Factors Causing Main Failures," JAWWA, 47:465 (1955).

How one operator cleverly built his own . . .

HOMEMADE ODOR—CONTROL DEVICE

by ARTHUR L. POGANSKI
Chief Operator
Sanitary District #1
Greenbrae, California

■ MOST SEWAGE treatment plant operators have odor control problems and, usually, very little money with which to control them. As this situation is prevalent the world over, this operator would like to inform others as to how these problems have been solved economically, both in initial structure and in operation, with a little ingenuity and some old odds and ends of equipment.



FURNACE SQUIRREL CAGE BLOWER and an Agitator combined to combat odor problems in homemade equipment.

An abandoned rectangular blower-type furnace was used with the heating element removed, but with the squirrel cage blower left intact and an agitator added to break up the odor control liquid (see Figure 1).

The blower is used to draw the foul air from its source (in this case a wet well at the pump station) and is blown over, around and through the agitator. The air then revolves in a reservoir containing an odor control liquid and is released into the atmosphere (Figure 2).

The agitator used here is a squirrel cage, 12 in. in diameter and 15 in. long, made of expanded metal. It revolves approximately at 50 rpm in a reservoir containing a diluted solution of National Chemsearch odor control solution (Solvex concentrate).

A syphon attached to the reservoir and a storage tank maintains a continuous desired level of odor control liquid. A thermostatically controlled heating element may be attached to further break up the solution.

In the pictures of the pilot model, the fan and agitator motors are enclosed in the air passage chamber. The permanent structure will be made using only one motor outside of the air flow chamber for both units. A reduction gear box will slow the revolutions of the agitator to about 40 rpm.

Modifications of this device may be made for any given situation without running into a large expenditure of money or time. Operators having these or other problems might follow the lead of the author and construct equipment from other unrelated devices.

AIR FLOW through homemade device. Equipment built by an ambitious operator.

Sewer Ordinance Fallacies

by JOHN E. KINNEY
Sanitary Engineering
Consultant, Ann Arbor,
Michigan

■ WHEN FRANK CLARKE gave us a "New Look at an Old Substance—Water", he not only demolished traditional knowledge but he effectively demonstrated how theories, even those that over a period of time have become accepted as theorems, may be shown erroneous.

Mr. Clarke asked, "What is water?" as a basis to develop its composition, uses, effects and controls on it. The answer was not a repetition of what hearsay, books or authorities have decreed. His objective could tolerate no such looseness. His objective is the continued effectiveness of the U.S. Navy.

A parallel can be drawn in the need to re-evaluate the code or scope of activity which can interfere with the continued effectiveness of community growth. The availability, use and re-use of water can most certainly promote or stunt the growth of a community.

This range of water management falls under two utilities even though such recognition is not publicly given: water supply and municipal waste disposal.

The recognition of water supply as a utility is general. The failure occurs in recognition of municipal waste disposal as a utility. The reasons are several. They include:

1. Construction of sewers and treatment plants has been considered an unnecessary and unproductive cost, so there has been organized resistance to acceptance of a pollution abatement program.

2. Benefits of construction of treatment facilities have been considered solely in terms of downstream water users, so treatment plant operation costs have been minimized. This is often done by employing inexperienced and untrained operators. Utility reports to regulatory agencies are subject to strict checking. State pollution control agencies are not staffed to give any such check to municipal plants on a routine basis.

3. Treatment plants are designed on basis of expected average and maximum flows and on basis of population. The population is considered in terms of pounds per day of solids and of oxygen-consuming material BOD. To be acceptable in most plant designs, an industrial waste then is compared on basis of volume of flow, solids and BOD. These "standards" of design criteria promote the concept there are two distinct types of waste in a city, body wastes and industrial wastes. The former are accepted; the latter are discouraged or excluded. The needs of the municipality rarely receive attention. A utility does not ignore potential customers. So waste treatment is not considered a utility.

4. A utility answers to a state or federal agency for its actions. A municipal treatment plant operates under a city sewer ordinance and can be as discriminatory as the council desires.

Sewer Ordinance Origin

The sewer ordinance sets the ground rules for the municipal operation. Since the sewers and treatment plants cost even the small cities millions of dollars, there is real incentive to give the ordinance detailed study. It should reflect specific, individual city needs and planning. The study should consider local conditions, evaluation of the state control agency requirements for the city and the type or types of waste originating in the city. Apportionment of cost of operation of the plant must be balanced with individual usage of the facilities.

Too often the ordinance adopted by a municipality is a verbatim duplicate of some other city's, a city that may or may not have the same type of treatment plant, the same costs, the same composition of waste. These ordinances may be adopted after the plant design is completed or even just prior to operation of the plant. There are cities with ordinances unenforced but held in reserve to use if trouble occurs. Such an approach is a definite indication the problems of the city were not defined. Such ordinances are not safeguards for community welfare.

Definitions

Frank Clarke's finding new answers to the question, "What is water?" suggests that the question, "What is sewage?" deserves attention. Basically, sewage is the flowing matter in sewers. Sewers are designed to carry the liquid wastes of civilization. So sewage must necessarily encompass these liquid wastes.

This definition finds support in a number of ordinances. Sewage is defined as the liquid wastes from residential, commercial or industrial establishments, together with any surface or storm water that may be present.

But here agreement stops. So does logic; so does completeness.

If we examine the wording of ordinances adopted by municipalities, the inconsistencies are apparent. These inconsistencies and, at times, omissions do not promote a common understanding of the community problem or the objectives of the ordinance.

For instance the ordinance, after defining sewage, may include a definition of "sanitary sewage" as the "sewage discharging from sanitary conveniences of dwellings, office buildings, factories and institutions, and free from storm and surface water and industrial wastes."

Note that sanitary sewage is free from industrial wastes. It is most difficult to conceive of any municipality that could exist under such a situation. But such a definition is even more difficult to understand when

the same ordinance defines a "sanitary sewer" as a "sewer which carries sewage and wastes and to which storm, surface and ground waters are not intentionally admitted". In other words, that which flows in a "sanitary sewer" is not "sanitary sewage".

Some ordinances seem to have been prepared in a hurry for some terms are used that are not defined. Sewage may be defined but not industrial wastes. Yet the ordinance will proceed to provide surcharges or restrictions on industrial wastes.

Then there are those ordinances which include the term "normal sewage". From their usage of the term these ordinances suggest liquid wastes with solids concentration or BOD concentration above some stated figure are abnormal. The abnormal is subject to surcharge or exclusion.

What defined the level of normality? Was it a check on the composition of the waste in the community and the figures developed as representative of that specific community? If so, then many of our cities have identical diets and community activity. In many instances it has been found these figures represent a measure of the population equivalents used for design criteria for the treatment plant. Since the cost of sewers and treatment plant is influenced most by volume of flow, then why consider the dilute sewage as abnormal?

The new name, "Water Pollution Control Federation", is real encouragement for those who argue other changes in nomenclature are in order. Is it not time to erase the greatest misnomer of all time, "sanitary sewage"? Is sewage "sanitary", regardless of its source? Is the sewer through which it flows "sanitary"? Are not our sewers from their earliest usage designed and constructed to carry municipal wastes or storm water? That was the basis for designating sewers as separate or combined. A change from that terminology would suggest a subterfuge to avoid the work needed for designing a municipal waste disposal plant to treat all the wastes of the municipality.

Excluded Wastes

Some ordinances include a section on excluded wastes. There is excellent reason to exclude wastes that are deleterious to sewers or treatment plants or are dangerous to personnel. The exclusion language though indicates more of a prohibition than a control to prevent difficulty.

A review of such sections in ordinances and a questioning of authors of the ordinances have permitted these conclusions:

1. The immediate reference was a previously adopted ordinance, and usually with no check with any agencies or authorities on possible new data.

2. There is often no actual knowledge of the original source of reference.

3. The figure is given with the assurance of an absolute number but with no thought as to the accuracy or sensitivity of the method of analysis. The fact that analytical methods for metals, for example, may have an accuracy of plus or minus 50% at the levels discussed is usually unappreciated.

4. The fact that different analytical methods may give widely differing results is usually not considered. There is a general reference to "Standard Methods" as the authority but "Standard Methods" may not have procedures for all limits.

There are two commonly employed expressions in the section of exclusions that merit attention. The first is the introductory expression, "Except as hereinafter provided, no person, firm or corporation shall discharge or cause to be discharged any of the following described waters or wastes to any public sewer." The list of exclusions follows. The "except as hereinafter provided" refers to a loophole clause towards the end of the ordinance that usually reads, "No statement contained in the above sections will be construed as preventing any special agreement or arrangement between the City and any industrial concern whereby an industrial waste or unusual strength may be accepted by the City for treatment." After positively forbidding the waste on the grounds acceptance will harm the sewers or treatment plant, the ordinance then suggests an agreement will remove the destructive characteristics of the waste. If there were any real assurance the exclusions were reasonable and necessary, such an exception should not be tolerated.

The second term is the word "any". The list of exclusions introduces each with "any". For example, the list states no person is allowed to discharge "any liquid or vapor with a temperature above 150° F." It makes no difference whether the quantity is a thimbleful or a thousand gallons; the exclusion is absolute.

Consider the restriction that prohibits "any water or wastes containing free oils, emulsified oils and grease exceeding an average of 100 ppm of ether soluble matter." Note that the limitation is on the average. If the oil is free mineral oil floating on the surface, a sample of the waste discharge taken below the surface will show the average volume of discharge has approval for discharge. Or, if the oily matter is discharged as batch dumps, sampling at regular intervals can easily show the acceptable average. In neither case is the desired protection obtained.

Consider also the exclusion indicates ether soluble material is oil or grease; and anything soluble in ether is oil or grease. Neither statement tells the story. Not all oils are able to be extracted with ether. Not all substances extractable with ether can be classified as oil or grease.

Would it not be better to define the objective rather than include a limit incorporating a method of analysis undergoing modifications?

Some ordinances suggest there is a real toxic menace in only a few ions, iron, zinc, cyanide, copper, nickel, chromium, phenol, lead, cadmium. They are introduced with the statement, "The limits of toxic wastes discharged into the public sanitary sewers shall not exceed the following concentrations." Naming these intimates all others are nontoxic. Naming them specifically directs attention to these few and diverts attention from such things as highly chlorinated organics that may be detrimental to plant and stream. What these wastes are toxic to is not noted.

The same fear of metals must prompt the clause, "under no conditions will the discharge of concentrated plating baths or acid pickling liquor be permitted, whether neutralized or not." The effect of a controlled discharge of neutralized solution at 1 gpm in a large sewer flow may be negligible, but it is forbidden.

It should not be forgotten there are 1440 minutes in a day and over

10,000 minutes in a week. A regulated discharge at a very low rate can still permit disposal of large volumes of strong wastes with no deleterious effect on sewer or treatment plant.

Some ordinances specifically exclude any discharges in excess of 200 gallons per minute. Yet some water customers buy water at a rate of over 200 gpm. The ordinance would also exclude any waste with more than three times the concentration of BOD or solids of "normal sewage".

If the objective is to prevent batch dumps of solution, then a general requirement for submission of plans to show means of equalizing discharges would be more effective. If the volume discharge is insignificant, then exceeding three times the values stated as representing the normal may not be measurable at the treatment plant, or even in the sewer. Again, it would be better for the industries to submit plans for controls on discharge and the data to show the basis for computing effect on the plant.

Some ordinances limit the pH range of water discharged to the sewer at 6 to 9, even in cities where water is supplied at pH above 9.

Some ordinances have provisions to exclude "any wastes which have excessive volume, BOD, color, chlorine requirements or settleable solids." The ordinance is most specific on some concentrations but leaves others to the discretion of some individual.

Surcharges

Few cities develop a basis for surcharges on actual cost of operation. The ordinance carries a formula for assessing charges that provides for extra costs to those contributors from outside the municipal corporate limits or to those contributors whose wastes show concentrations of BOD, suspended solids or chlorine demand above some arbitrary figure. These figures are called concentrations of "normal sewage."

Some ordinances define the chlorine demand to be considered as "normal" and charge for excess demand. The ordinance may note the procedure to be followed is in "Standard Methods". The fact is "Standard Methods" dropped chlorine demand as a method because of its meaningless results. Also, cities which do not chlorinate set charges on chlorine demand.

A common procedure is to set up a formula that adds the excess of BOD and solids, as either concentration or load, over the "normal" and determines a factor which when multiplied by the flow sets the surcharge in terms of equivalent volume of "normal sewage".

This formula suggests the plant is receiving a greater volume of flow than it does. This formula would charge the customer as though his waste were treated for both entities. But when the treatment plant has only settling facilities for primary treatment, the only service rendered is recovery of settleable solids. The BOD reduction is limited to that fraction that is in the settleable solids. And settling tanks do not recover all suspended solids. In most plants it is less than 60 per cent of the suspended solids. For many wastes from industry the percentage is much lower.

Some formulas would seem to be magnanimous by charging for only a percentage of the excess. The percentage is supposed to be related to the treatment provided. For a primary plant the figure may be 45 per cent. But the figure is applied to both solids and BOD as though the plant will provide that degree of treatment. Other cities, with a primary treatment plant and provisions for chemical addition during low-flow months, charge for the combined treatment all year.

Formulas for surcharge may have such statements as, "for each ppm of suspended solids or BOD, whichever is greater, over the normal measured for some period" and then set the rate. There is no stipulation on the number of tests to be run. There is no requirement tests be run in duplicate. There is no appreciation such intimated accuracy in analytical procedures does not exist. There is no correlation with any extra cost of treatment.

In short, there is no moral or economic justification for such formula procedures for surcharges. Such formulas would suggest the basis for plant design and operation is not engineering and actual cost of operation.

Joint City-Industry Approaches

Consulting engineers and city officials interested in promoting a cooperative approach with the industries in the city for joint treatment of wastes can show their ingenuity and creative ability in the sewer ordinance proposed and adopted and in the design of the treatment plant. This need for joint treatment acts as an incentive to develop new treatment means and controls. It sponsors originality of design, not perpetuation of past practice. After a plant is designed such joint activity may have to be on a trial basis before decision can be made on acceptability.

There are estimates some cities have 40 per cent of their flow to the treatment plant contributed by industry. With continually expanding urban areas purposely annexing industrial areas to obtain extra tax money, can we continue with the thesis treatment plants are for body wastes rather than for municipal wastes? Can we ignore our obligation to the present and future generations to provide a basis for continued community growth and coincident protection of our water supplies? The responsibility we have adopted, to control one of the most potent forces in man's environment, cannot be ignored.

Some cities have done some broadgage thinking and are reaping the benefits. Columbus, Indiana, for example, developed a team of municipal, state, industrial and consulting brains to design a municipal waste disposal program. Their theme was the city would provide facilities for treatment for any wastes originating in the city if it is cheaper for the city to treat the wastes than the industry. The extra cost of treatment is paid by the industry. The city does not subsidize the treatment. But both benefit.

Dearborn, Michigan, saved the taxpayers money and provided the solution to an industry's spent pickling waste by utilizing the spent acid to condition its sludge for incineration. Good communty relations were developed by the waste disposal superintendent, Michael Groen, because he was willing to work at accomplishing a solution to a joint problem: treatment of a waste and reduction of cost of plant operation. The APHA recognized the novelty of this approach in the Nichols award in 1957.

In my opinion more cities would reap these benefits if the city councils employed competent guidance and operators. The individuals who set the rules and make the decisions too often live by the creed, "someone said it couldn't be done, so the heck with it." The few who have said, "Let's try it", are the award winners.

Municipal Sewer Ordinances

A municipal ordinance should promote community development. It should outline objectives, designate authority, and be flexible to permit administration based on engineering studies of effect and cost.

The ordinance should state individual discharges will have to be evaluated separately and controls agreed upon. Such controls may be in terms of pretreatment, regulated discharge or haulage to the plant if concentrations or material would be such as to damage sewers or treatment plant. Since it is impossible to anticipate all conditions, there should be no attempt to provide limiting or protecting regulations in terms of specific constituents.

Surcharges should be computed on basis of actual cost to plant operation, not on preconceived formulas that presuppose "normal" sewage. Let the thesis be the treatment plant should best serve the municipal need and the cost should be assessed in terms of use of the plant.

There have been proposals to charge for the existing excess capacity of plants as a separate charge to industry in terms of available capacity ready for future usage. Such a proposal has merit if the original design of the plant was made with such an objective in mind and with the industries party to it. Such activity truly represents a joint municipal-industrial approach. However, when it represents a means of payment for an overdesign in capacity, then there is no such justification.

Since the sewer ordinance, the design and operation of the treatment plant, and the state pollution control program are so intimately related, all sewer ordinances should be reviewed by the state. The state agency has been established to protect the people of the state. When the actions of consulting engineers or city councils in this field are not in the best interests of the people, then there should be means of notifying the people by a review agency.

The state agency should require the preparation of an ordinance and a report on all waste loads in the municipality as parts of the report on treatment methods proposed. Such inclusion would show the means to be provided for proper control on waste discharges from the city.

Review of drafted ordinances would also permit pointing up the need for ordinances to include provision for hiring competent personnel so the benefits charged for can be delivered.

With a changing economy new criteria are needed for designing treatment plants and for evaluating the effect of the discharges on the rivers. The present rule of percentage reduction in BOD and solids is too crude. There is vital need for the question, "What is sewage?" to be answered as adequately as Frank Clarke has answered. "What is water?" at the U. S. Naval Engineering Experiment Station. A great impetus towards obtaining that answer will be obtained by ridding our sewer ordinances of their traditional fallacies.

Benefits

Recognizing municipal waste disposal as a utility will aid in promoting more effective, efficient and less costly municipal waste treatment. With constantly expanding urban communities there must be joint development of techniques for treatment of all wastes. There must be better treatment plant control and more effective treatment if the treatment plant effluents can serve as an industrial water supply. For many industries located on silt-laden streams, a municipal treatment plant effluent would provide better water quality consistently than the streams.

But with the present plants designed for BOD and solids reduction on a percentage basis and no positive controls against slugs of material, such as high dissolved solids, organics, detergents, etc., the industries would be ill-advised to use the water.

In smaller cities particularly the share of the tax burden borne by industry is sizable. Any savings in cost of operations or prolonging the effectiveness of existing facilities so as to postpone more construction is reflected in tax savings. More active participation by industry in the community treatment plant can result in immediate benefits. These benefits accrue to individual taxpayers as well as to industries. This participation will also keep the plant operating personnel alert. Better plant operation will result in fuller utilization of the facilities.

W&SW FUTURE FEATURES . . .

Manuscripts Scheduled for the Next Few Issues of WATER & SEWAGE WORKS

Metropolitan Syracuse Sewage Treatment Plant
S. W. Williams, Jr.
O'Brien & Gere
Syracuse, New York
Complete coverage of design features and equipment provided in this plant which will have stringent effluent requirements.

Water Utility Distribution Loss—Part 3
Dale Smelser
Knoxville, Tenn.
A continuation of the four-part series about water quantity accounting.

Convection-Solar Stills
Werner Grune
Georgia Institute of Technology
Atlanta, Georgia
A Research Progress Report of devices and procedures developed for desalting water using solar energy.

Critical Examination of the Multiple-Tube Dilution and Membrane Filter Methods for Coliform Enumeration
W. L. Mallmann and Frank R. Peabody
Michigan State University
East Lansing, Michigan
Results of extensive comparable analysis of marginal water samples using Dual Standard in current effect.

How much increase will the Southern climate permit in the . . .

Depth and Loading Rates of Oxidation Ponds*

by DONALD A. MILLS
Engineering Department
Hercules Powder Co.
Wilmington, Delaware

■ SINCE 1921, THE TREATMENT of organic wastes in stabilization ponds has received more and more attention. Many industries and small communities, finding this new method of waste treatment less costly than other methods, have constructed stabilization ponds rather than conventional waste treatment plants.

While a considerable amount of attention has been directed toward developing design criteria for stabilization ponds in the Northwest, little work of a similar nature has been undertaken in the South. As a result, the criteria developed for the much colder Northwestern climates have been generally adopted throughout the South, without regard to the move favorable climatological conditions prevalent in this area. Many have felt that as a result of adopting these rather conservative design features, stabilization ponds in the South have been designed and operated considerably below their possible safe capacity. As the number of installations of this type increased, speculation grew as to whether or not higher organic loadings were possible in these warmer climates.

At the University of Florida, as a result of studies on an experimental stabilization pond during the winter of 1957, Dykes[2] reported that the organic loading of lagoons in the north-central Florida area could be increased over four times that being used throughout the South. Organic lagoon loadings of 225 lb BOD/acre/day produced a stabilized effluent and did not cause any objectionable odor or appearance.

As a result of this earlier work, a further investigation was undertaken to verify these findings by studying similar organic loadings during other seasons of the year and also to evaluate the effect of pond depth on operating efficiency.

*This article is an abstract of a thesis presented to the Graduate Council of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Master of Science in Engineering.

Description of Facilities

This research was carried out at the Phelps Laboratory for Sanitary Engineering Research at the University of Florida. A rectangular concrete tank located on the grounds of the laboratory was used as an experimental pond. The tank has vertical sides and a flat bottom, and is 8 ft wide and 12 ft long, resulting in a surface area of 96 sq ft or 0.0022 acres. Comminuted and degritted raw campus sewage was fed to the pond by a device designed to allow the influent to be evenly distributed over the width of the pond, which is shown in Fig 1. The influent was pumped to the dosing device by a small centrifugal pump which was actuated by an electrical timer. The hydraulic dosing rate was accurately controlled by use of a calibrated bucket and adjustment of the pumping time.

Effluent was withdrawn over a 15 in. sharp crested rectangular weir. During the first two experiments a semi-circular baffle was placed around the weir to prevent the discharge of any floating solids; during the second two experiments the baffle was removed.

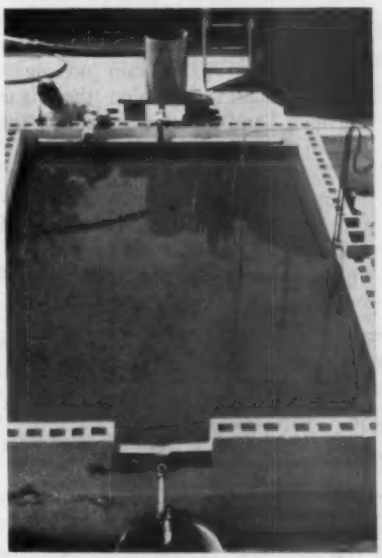


FIG. 1. AN OVERALL VIEW of the experimental pond.

When operated at a depth of 2.5 ft the pond had a volume of 1800 gal, and when operated at a depth of 3.5 ft it had a volume of 2500 gallons.

Experimental Procedure

In order to simultaneously study both the effects of heavy organic loadings and also the effects of pond depth on operating efficiency, four separate experiments, each of approximately two weeks duration, were employed. The main features of each were as follows: Experiment 1 Organic loading rate 200 lb BOD/acre/day Depth 2.5 ft; Experiment 2 Organic loading rate 300 lb BOD/acre/day Depth 2.5 ft; Experiment 3 Organic loading rate 200 lb BOD/acre/day Depth 3.5 ft; and Experiment 4 Organic loading rate 300 lb BOD/acre/day Depth 3.5 ft.

Organic loading rates were obtained by first approximating the sewage strength from previously obtained data and then calculating the required hydraulic dosing rate to yield the desired loading. No attempt was made to obtain comparable theoretical retention periods; this, being a function of hydraulic loading rate and pond volume, was allowed to vary as a function of these two parameters.

The pond was dosed every fifteen minutes, seven days a week, throughout the entire duration of the study. Continuous dosing was not possible due to the small size of the pond, but the dosing rates employed did result in a continuous discharge, which approached actual field conditions as closely as possible.

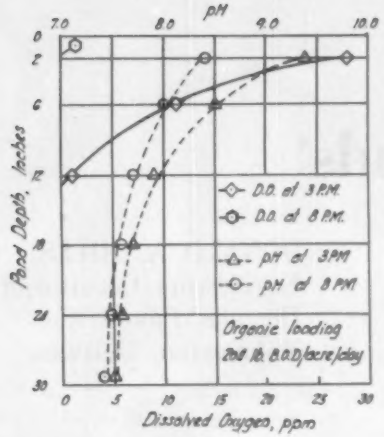


FIG. 2. THE EFFECT of optimum weather conditions on pond DO and pH.

During all experiments, raw sewage influent samples were collected and composited automatically. Effluent samples were collected four times daily at 9 and 11 AM and at 2 and 4 PM, composited, refrigerated, and analyzed the same day. Bacteriological samples were collected by grab sampling in sterile bottles and were examined within one hour.

Depth samples were also taken to obtain dissolved oxygen and pH data throughout the depths of the pond. An aluminum tube, placed midway between the dosing pipe and the effluent weir and reaching out approximately 2.5 ft from the bank was used to siphon samples from various depths. This tube may be seen in Fig 1.

Dissolved oxygen samples siphoned from the pond were collected in closed containers and the liquid was allowed to flow through the container several times before the sample was taken. To the samples thus obtained reagents were added immediately and titrations were made as soon as all the samples were collected and prepared. At the same time DO samples were collected, pH samples were also obtained in the same manner and analyzed immediately with an electrometric pH meter. Dissolved oxygen and pH depth profiles were obtained during both day and night at least twice during each experimental loading period.

Daily determinations were made of BOD, suspended solids, coliform index, and standard plate count on the raw sewage influent. For the lagoon effluent, alkalinity, BOD, NO_2, NO_3, coliform index, standard plate count and microscopic examinations were made daily. All tests performed and all reagents used in these tests were prepared in accordance with Standard Methods[3]. Algal cells were removed from effluent BOD samples by centrifuging for 15 minutes at a speed which produced a force of 1200 g, and all BOD tests were performed in triplicate.

Experimental Results

The results of the four experimental loading periods are presented in Table 1. At organic loadings of 200 lb BOD/acre/day, the pond operated successfully during both sunny and cloudy weather. Even on cloudy days, enough light was available to allow photosynthetic oxygen production to proceed at a rate sufficient to maintain aerobic conditions in the upper few inches of the pond and prevent development of any odor conditions.

During the early spring, the pond was a pleasant dark green in color, but, when summer arrived and the sunlight became more intense, the pond tended to become grey in color and appeared to contain no algae. Depth sampling revealed the algae lay in a band about 4 in. thick, the top of the algal layer remaining 2 to 3 in. below the liquid surface. Every evening about two hours before sunset the algal layer would suddenly rise to the surface and produce the normal green color characteristic of heavily loaded lagoons. This phenomenon was not effected by variation of operating depth or by changes in the organic loading, and was probably the result of the sunlight becoming too intense for optimum algal metabolism.

Experiments 1 and 3, during which an organic loading rate of approximately 200 lb BOD/acre/day was employed while operating depth was increased from 2.5 to 3.5 ft, produced remarkably similar effluents. Calculations showed a daily BOD removal of about 170 lb/acre/day. Coliform reductions were in excess of 85 per cent at all times, while effluent BOD varied between 25 to 30 mg/l. Traces of nitrites and nitrates were consistently present in the effluent, indicating the stabilization process to be well advanced. Previous investigations using similar organic loading rates during the winter months gave similar results, indicating that organic loadings of 200 lb BOD/acre/day are entirely feasible during all seasons of the year where warm or semi-tropical conditions prevail.

To determine if the stabilization process was operating near its maximum capacity, organic loadings of approximately 300 lb/acre/day were also studied, at operating depths of both 2.5 and 3.5 ft. After an increase of 100 lb BOD/acre/day in the organic loading rate, pond efficiency remained virtually constant; effluent BOD increased only 3 mg/l, averaging 33 mg/l, while nitrite and nitrate production remained essentially constant. Coliform reductions averaged 95 per cent, and no odors were noticed. *Gambusia* minnows introduced during earlier experiments increased in population and prevented any mosquito breeding.

During Experiment 2, other algal phenomena were noted. During this experiment a baffle protected the effluent weir, to prevent the discharge of any floating solids. When the organic loading was increased to 330 lb BOD/acre/day, algae concentrations became so great that a brilliant green algal scum formed rapidly and covered the entire pond surface. Although winds would occasionally break this scum, it would form again in only a few hours. The scum prevented light from reaching the algae present in the liquid, and seriously retarded oxygen production. The scum itself was held

Table I
Experimental Results

Experiment	Organic load, lb. BOD/ acre/day	Equiv Pop people/acre	5 Day BOD Inf mg/l	5 Day BOD Eff mg/l	BOD removal lb/acre/day	%	Coliform Index % reduction
1	204	1200	269	25.2	185	91	85
2*	331*	1950*	247	64*	245*	74*	89*
3	193	1135	241	29.5	170	88	98
4	309	1820	299	33	273	89	95

*Anaerobic digestion caused by algal scum formation

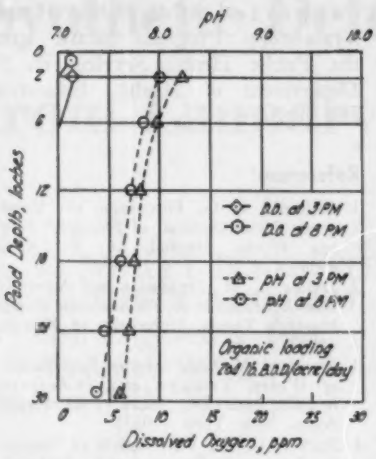


FIG. 3. THE EFFECT of adverse weather on pond DO and pH.

in place by the effluent baffle, and soon the pond became septic and odors were noticed. It should not be concluded, however, that the high organic loading rate *per se* caused the anaerobic conditions to predominate. Had the effluent baffle been removed to allow the algal scum to discharge freely with the effluent, the pond would have been able to maintain aerobic conditions and operate successfully. This was shown in Experiment 4.

Dissolved Oxygen and pH

Dissolved oxygen and pH relationships were studied throughout the depths of the pond. During sunny and even bright cloudy days, the upper few inches of the liquid were consistently supersaturated with dissolved oxygen, regardless of operating depth or organic loading rate. The depth to which oxygen penetrated within the pond appeared to be directly related to the amount of mixing and turbulence afforded by wind action on the liquid surface. After sunset, however, dissolved oxygen would quickly disappear. By two hours after sunset, no oxygen was found at even 2 in. below the surface, indicating that atmospheric reaeration contributed only a negligible amount of oxygen to the liquid. Even in the absence of oxygen during the night no odors were noticed, and the pond would quickly recover each morning.

In the upper few inches of the liquid where photosynthesis was most active, wide variations between day and night pH values were recorded. Algal uptake of carbon dioxide often resulted in pH values of 9.75 during the day, but as soon as photosynthesis would cease at dusk, the pH would drop rapidly until an equilibrium condition was reached. Below the euphotic zone, pH remained almost constant during both day and night, and varied only slightly with depth. The buffering action of the bicarbonates present would resist any extreme drop in pH during night and periods of inclement weather, and alkaline digestion conditions were never exceeded.

Fig 2 shows DO and pH conditions existing at an organic loading of 200 lb BOD/acre/day and with a liquid depth of 2.5 ft during optimum weather conditions. Fig 3 shows DO and pH values existing under the same depth and loading conditions, but during an extended period of extremely poor weather. Dissolved oxygen and pH values while the organic loading was held constant at 200 lb BOD/acre/day but operating depth increased to 3.5 ft are shown in Fig 4. When the organic loading rate was increased to 300 lb BOD/acre/day and operating depth maintained at 3.5 ft, neither the concentration nor the penetration of oxygen in the liquid was noticeably affected. Data obtained under these conditions are shown in Fig 5.

Algae

Throughout the four experimental loading periods, *Scenedesmus* and

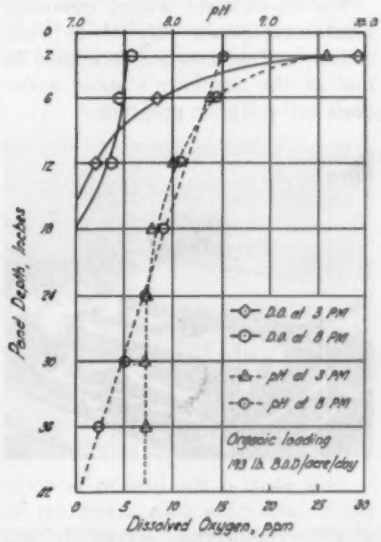


FIG. 4. THE CHANGE in DO and pH with increased operating depth.

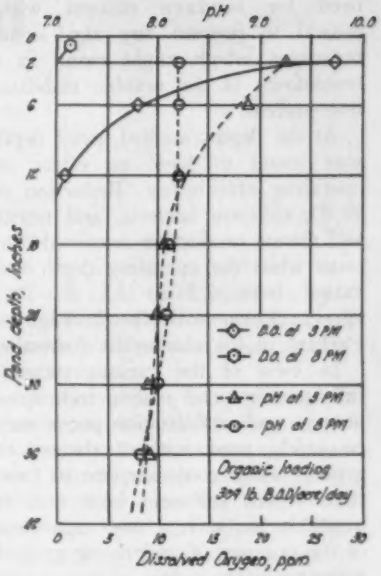


FIG. 5. VARIATION in DO and pH with increased organic loading.

Micractinium were continually present, although in widely varing numbers. They were generally the most dominant form, while *Euglena veleta, Euglena pisciformis* and various Chlorellaceae appeared from time to time. Occasionally the biological balance of the pond would become very unstable and a complete change in the dominant algal form would take place during one day's time. However, oxygen production was not affected by the changing algal populations.

Conclusions

While stabilization ponds have been shown to handle loads of 200 lb BOD/acre/day during both winter and summer, unfortunately studies did not include investigation of pond operation at the 300 lb/acre/day loading during winter months[2]. In view of this lack of data at the loading rate of 300 lb BOD/acre/day during the critical winter season of reduced sunlight intensity, the data obtained in this work at this highest loading rate would appear inconclusive for design purposes until similar operations can be undertaken and observed during the winter season.

The results of this work do, however, indicate the feasibility of organic loadings of 200 lb BOD/acre/day for stabilization ponds located in climates similar to that of north-central Florida. Results of this study also indicate a possible

need for surface effluent withdrawal to prevent any algal scum formation which might result in a breakdown of the aerobic stabilization process.

At the depths studied, pond depth was found to have no effect on operating efficiency. Reduction of BOD, coliform bacteria, and nitrite and nitrate production remained constant while the operating depth was varied from 2.5 to 3.5 ft. This agrees closely with the findings of Parker[4] in his studies in Australia.

In view of the various successfully proven pond sealing techniques now in use[5], stabilization ponds may be safely used without danger of ground water contamination in locations where sufficient land area is available for such a use, regardless of the porosity of underlying ground water acquifers.

Many small communities whose climates are similar to that encountered during the study may find stabilization ponds an economical method of waste treatment. The higher organic loadings, having been shown to be reliable and capable of producing a satisfactory effluent, would make the ponding process less land consuming, allowing capital that would ordinarily be spent on additional land purchases to be invested elsewhere, or if necessary, spent on bottom sealing measures for further protection of public health.

Acknowledgements

The author is sincerely grateful to Professor F. W. Gilcreas, under whose guidance this work was completed, and to Professor W. T. Callaway, who performed all biological analyses necessary. This work was supported by a Public Health Traineeship Program award from the Public Health Service, U. S. Department of Health, Education and Welfare.

References

1. Gillespie, C. G., Discussion of "Emergency Land Disposal of Sewage," Sewage Works Journal, **16:** 4 (April, 1944).
2. Dykes, G. M., *Oxidation and Nitrification Efficiencies in Stabilization Ponds,* Master's Thesis, University of Florida, (1957).
3. *Standard Methods for the Examination of Water, Sewage, and Industrial Wastes,* 10th Ed., Amer. Pub. Health Assn., New York (1955).
4. Parker, C. D., Purification of Sewage in Lagoons, *Sewage and Industrial Wastes,* **22:** (June, 1950).
5. McDermott, J. H., *Recent Observations at the Lebanon Experimental Stabilization Ponds,* Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio (Oct., 1959).

Clinton Bogert Retires

Clinton L. Bogert has retired from the consulting firm, Clinton Bogert Engineers, effective July 1, 1961.

He will continue to serve the firm in a consulting capacity. Remaining partners who will continue to operate the firm are: Ivan L. Bogert, Robert A. Lincoln, Charles A. Manganaro, and William Martin. The organization will continue to operate its offices in New York City, Hackensack, N. J., and South Norwalk, Connecticut.

Gotaas Appointed To Great Lakes Commission

Dean Harold B. Gotaas of the Technological Institute at Northwestern University has been entrusted with an important assignment.

Governor Otto Kerner, Ill., named Gotaas to the Great Lakes Commission and secretary of the five-man Illinois delegation in June. This group is designed to help the Great Lakes states and Canada work together in sharing one of their greatest natural resources—the five big lakes.

Risley Appointed to Federal Post

Roger E. Risley, vice president and director of engineering for Dresser Manufacturing division of Dresser Industries, Inc. has been named assistant director for mobilization planning, Water and Sewage In-Industry and Utilities division of the U. S. Department of Commerce's Business and Defense Services Administration.

Mr. Risley accepted the post under an arrangement whereby industry makes key executives available for temporary assignment with the government. Terms of service are usually six months, and the executives serve without government compensation.

Vancouver Opened The Lions Gate

The Lions Gate sewage treatment plant was opened July 31 in Vancouver and is a major milestone in one of the continent's most ambitious anti-pollution programs.

This plant is the first to be completed under the plan drawn up by a 1953 engineering survey. It will be followed in 1963 by a larger Iona Island plant to serve Vancouver proper, Burnaby and the University District. Other plants are also planned.

The Lions Gate is a primary plant, designed to serve 32,000 with room to expand to a 64,000 person service, built at a cost of $1,225,000. It is located alongside the north end of Lions Gate Bridge, at the entrance to the First Narrows.

Dr. Harold E. Orford Dead at 47

Following a long illness, Dr. Harold E. Orford 47, professor of sanitation at Rutgers, died Monday, July 10. Previously Chairman of the Department of Sanitation of Rutgers' College of Agriculture and Agricultural Experiment Station from 1954 to 1957, he had resigned as Chairman due to ill health.

Roy B. Everson Dies

Death has brought an end to the career of Mr. Roy B. Everson, at 81. A forthright fighter and pioneer in the water purification field, Mr. Everson conceived, developed, built and sold his own chlorination devices for many years.

He rarely missed the major national association meetings and would speak casually and at length about early developments in the industry. His presence and counsel will be missed, but his firm, the Everson Manufacturing Corporation, will continue.

Synthetic Detergent Removal from Laundry Wastes

by W. WESLEY ECKENFELDER
and EDWIN BARNHART
Civil Engineering Dept.
Manhattan College
New York, New York

■ THE PERSISTENCE of synthetic detergents discharged into ground waters has created a problem in well water supplies. One of the primary sources of synthetic detergent has been the discharge of untreated wastes from small laundry and laundramat operations. As a result of this problem, restrictions have been placed on the installation of laundramats, particularly in those areas of the state utilizing ground water supplies. In view of these considerations, studies were conducted to evaluate possible chemical methods of treatment in conjunction with carbon adsorption.

The results of this project indicate that laundramat wastes can be treated with alum and activated carbon to produce a clear effluent with less than 1-2 ppm of synthetic detergent (measured as ABS) remaining in solution.

Source and Characteristics of Wastes

This study was directed primarily toward the treatment of wastes from laundramat and small laundry operations. Operating data were obtained from several laundramats to determine the volume and characteristics of wastes discharged from the washing operations.

A typical installation sampled during this study contained 30 washing machines each of which used 30 gallons of water on a half-hour operating cycle. Of the water used, 22 gallons were hot water (140°F) and 8 gallons cold water such that the average waste temperature was 100°F as discharged. Under normal operating conditions there are 50 cycles/week/machine or a total weekly waste water volume of 45,000 gallons. The average characteristics of the composite waste are summarized in Table 1. It will be observed that the detergent concentration (as ABS) may be expected to vary from 50-90 ppm.

Principle of Treatment

Wastes from laundramat operations contain dirt, lint and other contaminants in suspension and colloidal dispersion and soap and synthetic detergents in solution. Treatment of detergent bearing waste is a three-stage process; the AL^{+++} ions causing a salting out process and preparing the detergent molecule for adsorption, the syndets being adsorbed on activated carbon and the colloids and dispersed carbon being coagulated and precipitated with alum. Application of sufficient carbon and alum will result in substantially complete removal of all the contaminants and a clear, inoffensive effluent.

Adsorption is that phenomena whereby substances of large molecular size will concentrate on a surface. The degree of adsorption depends primarily on the nature and concentration of the dissolved material and on the characteristics of the adsorption surface. Most adsorption processes can be formulated by the Freundlich Isotherm:

$$y/m = K C^{1/n} \quad (1)$$

in which y/m is the amount of material adsorbed per unit weight of adsorbent, C is the concentration of material remaining in solution at equilibrium and K and 1/n are empirical constants. As can be deduced from Equation (1), in order to attain substantially complete removal of the dissolved phase, large quantities of adsorbent must be used.

Studies in the initial phase of this study showed that the degree of adsorption was enhanced by the presence of high valence cations. After adsorption, the waste contains dispersed carbon and other impurities in colloidal suspension. These con-

Table 1

Analysis of Typical Laundramat Effluent*

1959	Turbidity[1]	COD ppm	ABS ppm	pH	Suspended Solids ppm
2/21	218	—	—	8.1	140
2/23	208	405	—	8.0	—
2/28	221	344	—	7.9	163
3/ 7	281	445	—	—	—
3/14	300	350	50	7.7	150
3/26	—	—	50	—	—
3/29	—	—	90	7.0	—
4/ 1	—	—	73	—	—
4/ 2	—	404	62	—	—
4/ 3	—	356	82	7.4	—
4/ 4	—	—	72.2	—	—
4/11	—	—	60.0	7.1	—
4/18	—	—	85.0	7.2	—
4/27	—	—	81.1	—	—

*Samples obtained from holding tank at Cole Wash Amatic installation at Hicksville, L. I. Sample represents 24 hr. composite.
[1]Based on an arbitrary scale setting; pure water equal to zero.

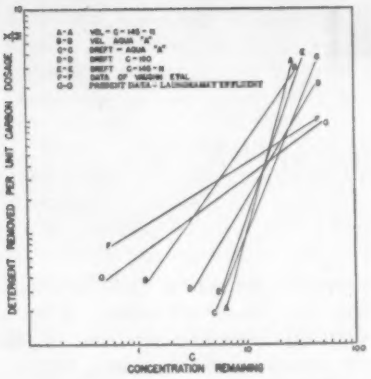


Fig. 1. REMOVAL OF COMMERCIAL synthetic detergents with various types of activated carbon.

stituents can be removed by flocculation and coagulation with alum. The alum dosage required to accomplish the coagulation will depend upon the nature of the colloidal particles and on the type of dissolved solids in the waste. Surface active agents tend to disperse the colloids and deflocculate the suspension. An increased alum dosage is usually required to overcome the dispersive action. An increased time of floc formation is usually required in the presence of synthetic detergents. High coagulant dosages are required in the case of laundramat wastes.

Previous studies were conducted at Manhattan College[1] on the removal of commercial synthetic detergents with various types of activated carbon. The detergents used in these studies were of the alkyl sulfate and alkyl benzene sulfonate types. Several types of carbon were also employed. Detergent concentration was measured employing a two-phase titration procedure. The experimental data obtained in these studies conformed to the Freundlich Isotherm Equation (1). The data obtained are summarized below and are shown in Figure 1.

The conclusions drawn from these studies indicate that adsorption is influenced both by the nature of the detergent and the type of carbon.

Studies were conducted by Vaughn et al[2] to evaluate the removal of detergents with various types of adsorbing and coagulating agents. They employed a 20 ppm concentration of a commercial anionic detergent. Their data conformed to the Freundlich Isotherm and is also shown in Figure 1. Carbon dosages of 10 lbs C/lb detergent were required to reduce the remaining concentration of detergent to 1 ppm or less. Alum dosages with activated silica of 60 ppm resulted in a 40 per cent reduction of detergent. Ferrous sulfate was found to be more effective than alum-silicate in the removal of detergent. Figure 1 also contains data obtained in present studies.

Experimental Procedures

General

The evaluation of the feasibility of treating laundramat wastes containing variable quantities of synthetic detergents by coagulation and adsorption was conducted in two phases. In the first phase, the adsorption characteristics of a pure anionic detergent (alkyl benzene sulfonate) were evaluated in the laboratory using several types of activated carbon. Variables such as pH and the effect of concentration of various inorganic salts on the adsorption were studied.

In the second phase of the project treatment studies were conducted on composite waste from a typical laundramat. Treatment was accomplished using alum, soda ash, and an activated carbon selected from Phase I of the project. The variables evaluated in this study were coagulant and carbon dosage, effects of pH, and sludge settling and compaction characteristics. Further studies were conducted to evaluate—

a. inter-relationship between carbon and alum dosage and pH of coagulation:
b. optimum sequence of addition of carbon and alum:
c. effects of re-use of the alum-carbon sludge for subsequent treatment operations.

Phase I—Detergent Removal Characteristics

Alkyl benzene sulfonate (ABS) was selected as a typical surfactant present in many commercial synthetic detergents for preliminary study. A standard sample of this material (62.4 per cent surfactant) was obtained from the American Soap and Glycerine Producers Association and was used in all experiments.

Mixtures of ABS with various additions of salts were employed, each containing 50 mg Nuchar 190N. These mixtures were allowed to stand for one hour at 25°C with occasional shaking. The degree of shaking seemed to have no effect so long as it was done every 10-15 minutes. The carbon was then removed by filtration. An ABS analysis made on the filtrate by the Degens-Jones method. Blank runs were made on the salt solutions without ABS present and indicated that the analytical method was not affected by the amounts of Ca^{++}, Mg^{++} and Al^{++} used.

The pH of the solutions was measured with a Beckman Model G meter. For the mixtures employed they are:

	Initial pH	Final pH (after filtering off C)
$CaSO_4$	6.4	5.5
$MgSO_4$	6.4	4.6
$Al_2(SO_4)_3$	3.9	3.7

The fall in pH is probably due to the hydrolysis of the salts and the slightly acid character of the carbon. The Nuchar 190N contained some water soluble acidic substances since its addition lowered the pH of distilled water.

Phase II—Laundramat Waste Treatment Studies

a. Initial studies were conducted on the laundramat wastes to deter-

Detergent Fraction*	Organic Carbon	Temp. °F	Isotherm**	Detergent to Carbon Concentration Ratios Covered
(1)	Aqua "A"	70	$C=30\ (X/M)^{1/2.13}$	1:.78 to 3.33:1
(1)	C-145-N	74	$C=21.8\ (X/M)^{1/2.75}$	1:8.1 to 4.00:1
(1)	C-190	74	$C=28\ (X/M)^{1/1.51}$	1:12.5 to 10.00:1
(2)	C-145-N	74	$C=19.2\ (X/M)^{1/4.05}$	1:10.15 to 3.90:1
(2)	Aqua "A"	74	$C=14.8\ ((X/M)^{1/1.295}$	1:4.05 to 3.57:1

(1)—Alkyl-Sulfate
(2)—Alkyl-Benzene Sulfonate
* —various commercial detergents were studied
** —general form of isotherm $C = K(X/M)^{1/n}$

[1]Quirk, T. P. et al "Studies on the Removal of Synthetic Detergents with Activated Carbon" Manhattan College Research Report.

[2]Vaughn, J. C., Falkenthal, R. F. and Schmidt, R. W. "Effects of Detergents on Water Treatment" Report Task Group, "Effects of Synthetic Detergents on Water Supplies" A.W.W.A. (1957).

mine the optimum alum dosage and the optimum pH of coagulation. Since the removal of the detergents present was negligible without the addition of an adsorbent, turbidity was used as a parameter of treatment efficiency. Standard coagulation procedures were employed.

b. Using the optimum pH and alum dosage selected from (a) above, a series of jar tests were conducted in which the carbon dosage was varied. In each case, carbon was added to the test solution and flocculated for ten minutes. The previously determined dosage of alum and soda ash was then added and the sample flocculated for an additional ten minutes. Following flocculation the samples were settled for one hour. The remaining concentration of synthetic detergent was determined on the supernatant.

After a survey of available methods of detergent analysis the Degens-Jones methylene blue test was selected for analysis of detergent as ABS. While this test is subject to interference at low concentration (below 5 ppm), it has the advantage of being easily performed and has found wide use in such studies.

In order to confirm the inter-relation between chemical dosage and pH, a series of tests were conducted in which the pH was varied using the previously determined carbon dosage. The alum dosage was also varied to determine if any reduction in coagulant could be obtained at the optimum carbon dosage.

Several series of tests were conducted in which the sequence of chemical addition and the time between chemical addition was varied.

c. In order to attain the greatest economy in treatment operation, the use of previously formed sludge as a partial coagulant and adsorbent was investigated. In these series of tests, the waste was coagulated using previously determined optimum coagulant dosages, settled and the supernatant decanted. Fresh waste was added to each of six samples and coagulated using varying dosages of chemicals. This cycle was repeated for three runs and treatment results recorded.

d. The settling and compaction characteristics of the sludge resulting from the chemical treatment was evaluated on a representative selection of samples.

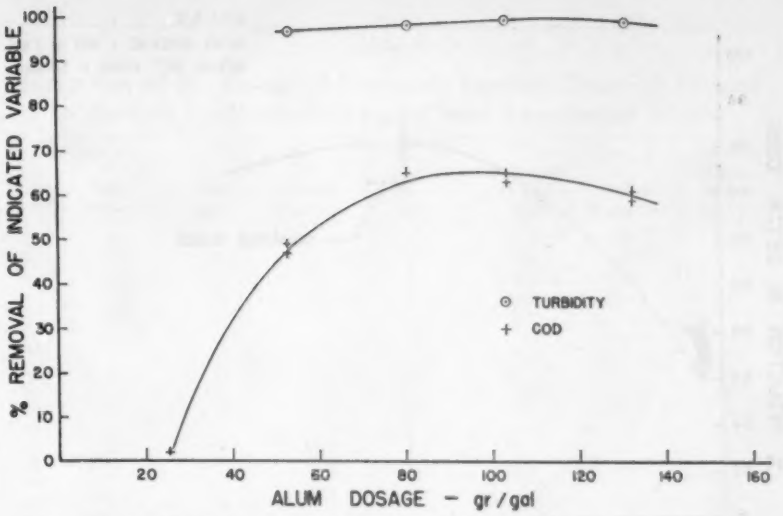


Fig. 2. REMOVAL CHARACTERISTICS of turbidity and COD with varying alum dosage.

Discussion of Results

Phase I

Preliminary experiments showed that while carbon would remove some ABS (15 per cent from 100 ppm ABS) it would not of itself be effective enough to be economically attractive. It was believed that addition of metal salts might exert a salting out effect and increase adsorption. As was expected, the sodium ion had little effect and in fact the detergent sample had considerable Na_2SO_4 as an impurity in its manufacture. It was thought that Ca^{++}, Mg^{++} and Al^{+++} would be more effective and these ions were used in the form of sulfate. The results of these studies are shown in Table 2.

Table 2

Effects of Various Ions on ABS Removal by Activated Carbon

	Composition of Mixture	ppm	Removal of A.B.S.
	Calcium Sulfate		
I	$CaSO_4$	10	
	ABS	100	57
	C	500	
II	$CaSO_4$	20	
	ABS	100	43
	C	500	
III	$CaSO_4$	30	
	ABS	100	41
	C	500	
	Magnesium Sulfate		
I	$MgSO_4$	10	
	ABS	100	52
	C	500	
II	$MgSO_4$	20	
	ABS	100	45
	C	500	
III	$MgSO_4$	30	
	ABS	100	41
	C	500	
	Aluminum Sulfate		
I	$Al_2(SO_4)_3$	10	
	ABS	100	8
	C	500	
II	$Al_2(SO_4)_3$	30	
	ABS	100	55
	C	500	
III	$Al_2(SO_4)_3$	50	
	ABS	100	90
	C	500	

Note: A white ppt. found in each case with $Al_2(SO_4)_3$.

The Ca^{++} and Mg^{++} were about equal in effectiveness in ABS removal. No explanation is available as to why the effectiveness fell off with increasing concentration. Al^{+++} gave the most promise at higher concentrations. Since a precipitate is formed in each case the phenomenon is apparently due to colloidal action plus adsorption. The two are related since very little ABS was removed by addition of $Al_2(SO_4)_3$ without carbon.

Phase II

Studies were initially conducted to determine the optimum pH and coagulant dosage to clarify the waste water. In each case alum was used as the coagulant and soda ash to adjust the pH. From several series of jar tests the optimum pH of coagulation was found to vary from pH 5.8-6.2. The turbidity removal falls off markedly at pH levels above and below this range.

The optimum alum dosage for turbidity and COD removal was found to vary from 80-110 gpg. Removal of detergent with alum treat-

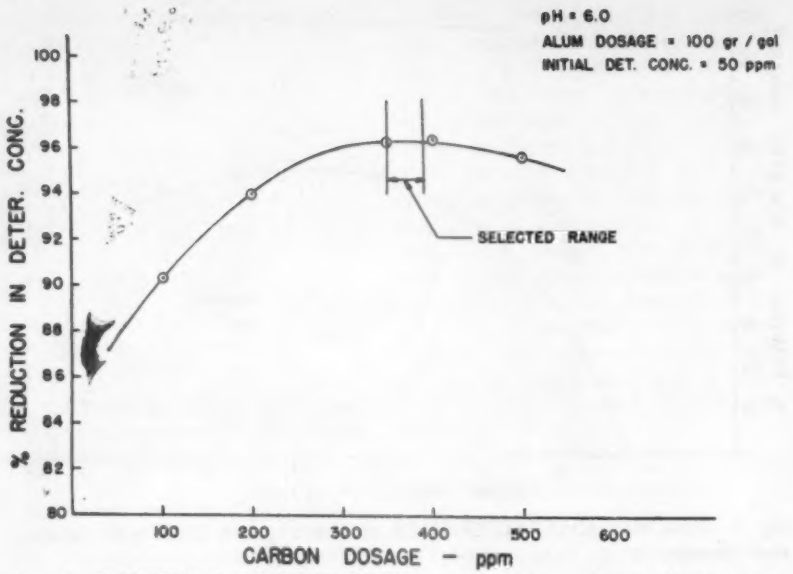


Fig. 3. EFFICIENCY OF DETERGENT removal with varying carbon dosage.

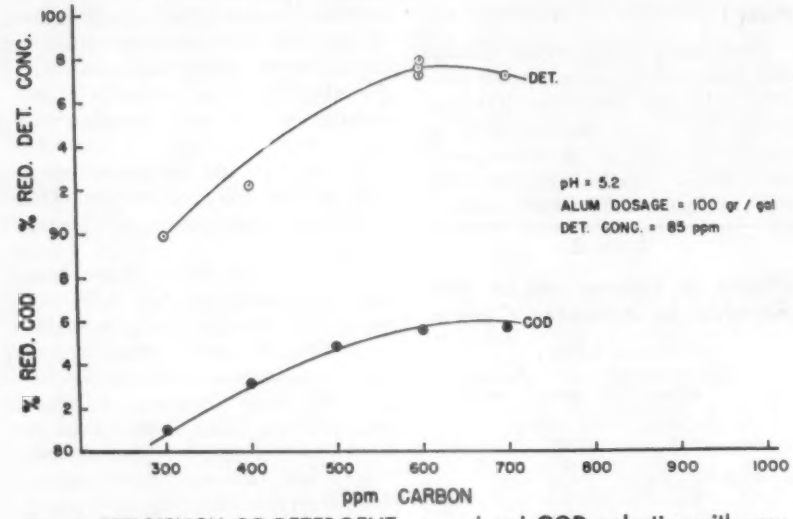


Fig. 4. EFFICIENCY OF DETERGENT removal and COD reduction with varying carbon dosage.

ment alone was negligible. Results of two typical runs are shown in Figure 2.

Detergent (measured as A.B.S.) is removed by activated carbon. (Nuchar 190N was used throughout this study.) Removals of 96-98 per cent were obtained with carbon dosages of 300-400 ppm. This resulted in effluent concentrations of 1-2 ppm as A.B.S. The methylene blue test is subject to error at low concentrations of detergent so that values less than 2 ppm may be subject to as much as 50 per cent error. Due to interferences in the test, it is probable that the low concentrations of detergent reported after treatment are higher than that concentration which actually exists. From the various series of tests conducted a carbon: detergent dosage of approximately 7:1 is required for optimum removal. The removal characteristics of carbon for two series of tests are shown in Figures 3 and 4.

It is found that the time sequence between addition of chemicals had no effect on the treatment result. It was necessary to add the carbon first in order to insure complete flocculation and removal of the alum and carbon after treatment.

When carbon is employed in conjunction with alum, superior results are obtained by operating at a slightly lower pH range than that found with alum alone. A pH range of pH 5.2-5.5 was found to give slightly superior results to pH values in excess of 5.6. Typical data are presented in Table 3.

In operating a batch treatment system, sludge would not be removed after each treatment cycle. In addition, it was felt that previously formed sludge still had some detergent removal capacity. From several series of runs, it was found that 60-70 per cent removal of detergent could be attained from previously formed sludge without the addition of chemicals. Attempts to re-use sludge more than twice resulted in a light bulky sludge of high volume. Typical data obtained in this part of the study are shown in Table 4.

After treatment, the sludge produced compacts to its ultimate concentration in approximately 4 hours. The concentration of sludge attained varied from 1-2 per cent by weight

Table 3

Effect of Activated Carbon on the Removal of Synthetic Detergents from a Laundramat Waste Water

	Alum	pH	Carbon	ABS ppm	COD ppm	Notes
Raw Waste	—	7.4	—	82	356	
	53.3	5.2	29.3	11.8	48	
	80	5.1	29.3	9.0	57	
	106	5.1	29.3	6.1	54	
	106	5.2	17.6	8.4	70	
	106	5.2	23.4	6.0	60	
	106	5.2	35.0	1.6	54	
	106	5.2	40.8	2.1	51	
	106	5.2	58.5	1.5	—	
	106	5.2	35.0	0.8	—	3 additions over 1 hr.
	106	5.2	35.0	1.4	—	20 min. carbon mix
	106	5.2	35.0	1.7	—	before adding alum
	106	5.2	35.0	1.8	—	20 min. alum mix
	106	5.2	35.0	1.2	—	20 min. mixing time
	106	5.2	35.0	1.3	—	with carbon & alum

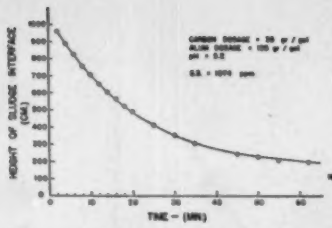


Fig. 5. TYPICAL SLUDGE settling curve.

and occupied approximately 10 per cent of the original waste volume.

Sludge Settling and Compaction

The sludge formed from the adsorption and coagulation reaction is flocculent and settles as a blanket forming a distinct interface between the floc and the supernatant. The initial settling rate is a constant and depends on the concentration of flocculent suspended solids. In the various waste mixtures studied in this project the sludge mixtures varied in suspended solids content from 946 to 2916 ppm and the initial settling rate from 1 to 4 ft/hr.

From the various studies conducted on sludge settling it was found that the ultimate compaction level reached was related to the initial concentration of the suspension. It was further found that this ultimate concentration was substantially reached after four hours settling. Over a range of initial solids of 946 to 2916 ppm ultimate sludge concentrations of 1 to 2.1 per cent by weight were found. This is approximately equivalent to 10.5 to 18.0 per cent by volume of the original waste volume. The data obtained is summarized in Table 5.

Table 4

Evaluation of the Re-use of Previously Formed Chemical Sludges to Remove Synthetic Detergents from Laundramat Waste

Sample	ML added	Alum gpg	Carbon gpg	pH	Detergent as ppm ABS	Percent Reduction	Percent Sludge Settled by Vol.
1	750	106	35.2	5.1	1.2	97	
2	750	106	35.2	5.1	1.3	96.8	
3	750	106	35.2	5.1	2.2	94.5	
4	750	106	35.2	5.1	3.0	92.8	
5	750	106	35.2	5.1	2.8	93.0	
1A					15.2	62.0	35
2A		106	35.2	5.1	9.0*	77.5	75
3A		58	35.2	5.1	10	75	37.5
4A		106	17.6	5.1	9.4	76.5	50
5A		58	17.6	5.1	9.0	77.5	33.7
1B					24	40	26.5
2B		106	35.2	5.1	12	70	81.5
3B		58	35.2	5.1	8.0	80	43
4B		106	17.6	5.1			78
5B		58	17.6	5.1			48

A refers to first re-use of sludge.
B refers to second re-use of sludge.
*in doubt.

Table 5

Summary of Settling Characteristics of Chemical Sludge from Laundramat Waste Treatment

Carbon gpg	Alum gpg	pH	Initial Solids ppm	H_o cm	t_c min	H	H 4 hrs	C 4 hrs
35	80	5.2	1906	325	21.0	135	137	13,900
35	105	5.2	1070	385	27.0	110	110	9,740
35	130	5.2	1926	420	29.2	180	180	10,700
26.2	80	5.2	1708	325	19.0	105	105	16,250
26.2	105	5.2	946	350	28.7	120	120	7,850
26.2	130	5.2	2070	460	28	150	150	13,800
46.8	80	5.2	2370	330	22.2	140	140	16,900
46.8	105	5.2	2916	455	22.5	150	150	19,750
46.8	130	5.2	2828	460	25	130	130	21,700

Conclusions

From the studies conducted under this project it may be concluded that:

1. Through a combination of physical adsorption and chemical coagulation it is possible to remove substantially all of the anionic synthetic detergent in wastes from laundramat operation.
2. Because of the interferences in the methylene blue test for detergent, measured concentrations less than 5 ppm are subject to error.
3. The amount of carbon required for complete treatment is approximately 7 parts carbon to 1 part detergent reported as ABS. An alum dosage of 100 gpg will produce a complete clarified effluent.
4. Settling studies indicate that a settling period of 4 hours will result in a sludge containing 1 to 2 per cent solids.

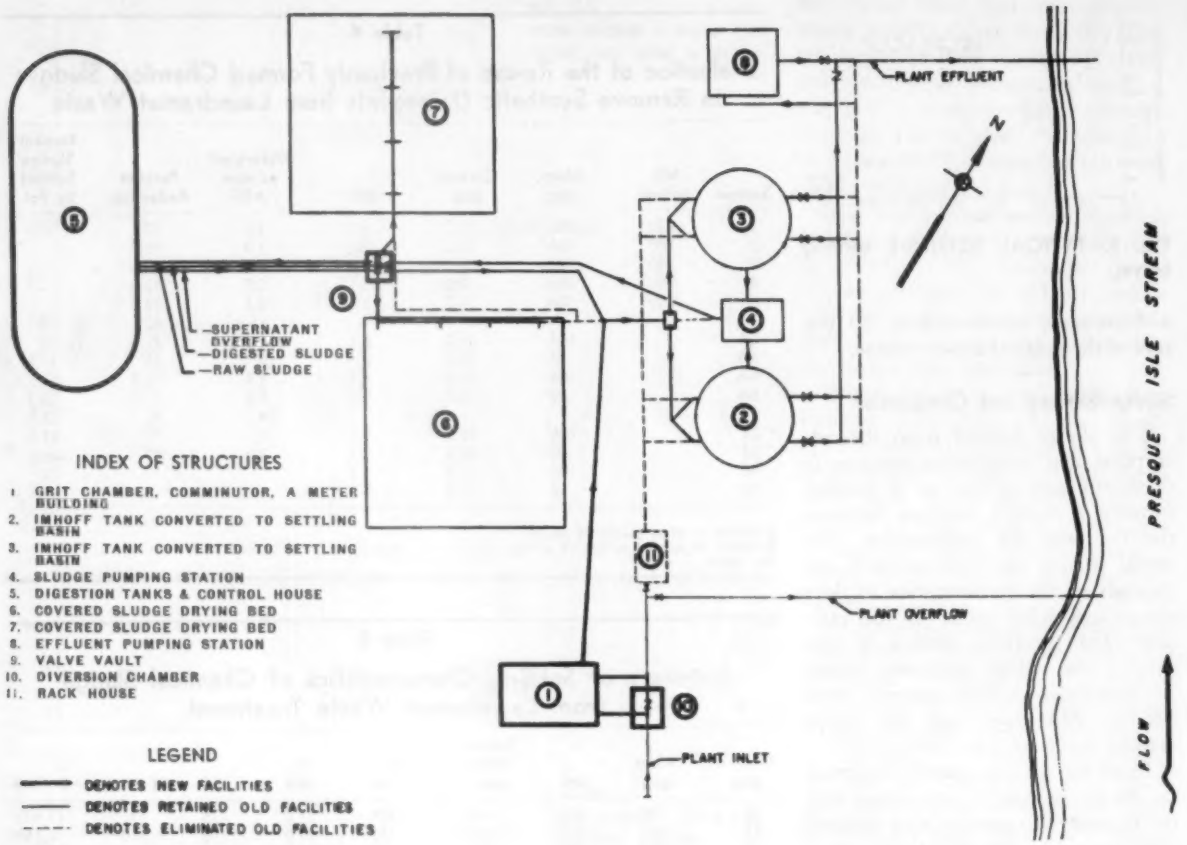
Summary of Design Criteria

Waste Concentration, ppm as ABS

Chemicals Required	
Alum Dosage, lbs/1000 gal	11½ to 18½
Soda Ash, lbs/1000 gal	2¼ to 4.0
Activated Carbon, lbs/1000 gal	3.0 to 5¼
Sludge Produced	
Concentration, percent	1 to 2
Lbs/1000 gal	15 to 25
Gal sludge/1000 gal	105 to 180
Effluent Concentration, ppm as ABS	1 to 2

Acknowledgement

These studies were conducted under a grant from the New York State Water Pollution Control Board. The first portion of these studies were conducted under the direction of Dr. A. B. Kemper, Head, Chemistry Department, Manhattan College. The help of the following is gratefully acknowledged: Mr. Jack Flynn of the Suffolk County Health Department, for his advice during the study: Mr. C. Rivotta of the Cole-a-matic Corp, for their cooperation in securing waste samples and to William Keane and Richard Johnson who assisted in the collecting of data and other laboratory analysis.



PLAN VIEW of rehabilitated plant.

Rehabilitation of Presque Isle Sewage Treatment Facilities

by EDWIN B. COBB, Partner
Metcalf & Eddy, Engineers
Boston, Massachusetts

■. POPULATION GROWTH, greater per capita sewage contributions, and industrial development are three key factors contributing to the inadequacies of many existing sewage treatment facilities throughout the country. However, the solution need not require the drastic measure of completely new facilities. A rehabilitation design, such as that instituted for Presque Isle, can in many instances solve the problem.

Constructed in 1928, the sewage treatment plant of the Presque Isle Sewer District was the first such facility in the State of Maine. The plant employed Imhoff tanks, and was designed for an essentially residential type service, adequate for a population of 5,000.

Difficulties Develop

Over the years, difficulties were encountered because of the severe winter climate of this Northern region. Specifically, the Imhoff tanks were covered with planks at the beginning of the winter season for protection against freezing temperatures, resulting in the tanks being inaccessible for cleaning during the winter months. During this period, scum and floating matter collected on the surface, eventually forming a solidified mat of scum up to 18 in. thick.

As the thickness of the congealed scum increased, the settling action in the tank became more confined and the detention time grew shorter. Increasing amounts of solids, that would normally settle out, remained in suspension, and were carried through the effluent piping to the stream. In addition, the settled sludge in the Im-

hoff tanks was cooled considerably because of the low temperature of the surrounding groundwater, further inhibiting digestion. The removal of suspended solids had reduced from a normal of 50 per cent to about 30 per cent, and the normal 30 to 35 per cent reduction of BOD had diminished to about 12.5 per cent.

Another factor contributing to the reduction in treatment efficiency was the sewage overload resulting from a 60 per cent increase in Presque Isle's population above the design population of 5,000. Projected population figures, developed by Metcalf & Eddy of Boston in conjunction with a survey of sewerage facilities, indicated that the population of Presque Isle could be expected to reach a total of 10,000 by the year 1975, and a total of 12,800 by the year 2000. The combination of this progressive increase in load and the inadequacies of the existing treatment plant would eventually develop into a critical situation. Compliance with the Maine Water Improvement Commission's classification of rivers and streams for the required treatment of discharged sewage was also in order, requiring more efficient treatment. With federal and state funds available to help defray the cost of such a project, a program of improvements was undertaken.

Metcalf & Eddy recommended rehabilitation and improvement of the existing facilities, rather than construction of a new plant. This solution was selected inasmuch as it would not only meet future loadings extending to the year 2000, but would involve less than half the cost of constructing a new treatment plant.

Existing Facilities

The Presque Isle Sewer District's sewage treatment plant is located adjacent to Presque Isle Stream, just northwesterly of the end of Dyer Street. The original facilities consisted of a manually-raked bar screen, two circular Imhoff tanks, two glass-enclosed sludge drying beds, a pneumatic sludge ejector, a pumping station for lifting Imhoff tank effluent to the stream in periods of high river level, and a bypass conduit to the stream.

As previously mentioned, the need for insulating the Imhoff tanks against winter temperatures resulted in the use of two-ply wooden covers, with an air space between. Although the covers served this purpose adequately, they also were responsible for the adverse scum accumulation in the tanks. The severity of the climate, coupled with the lack of weather protection for operating personnel further hindered Imhoff tank operation. Temperatures of —55° F have been reported at Presque Isle.

Plant Rehabilitation

The design flows are as follows: for the year 1975, an average flow of 0.9 mgd and a maximum flow of 2.25 mgd; for the year 2000, an average flow of 1.28 mgd and a maximum flow of 3.2 mgd.

The problem of poor sludge digestion was solved by providing separate heated sludge digestion tanks. The Imhoff tanks became primary settling tanks only. With this arrangement, sludge collected in the Imhoff tanks can be transferred daily to the heated digestion tanks.

Heated Sludge Digestion Provided

The design for separate heated sludge digestion called for two tanks, each having a capacity of 22,500 cu ft. The total volume provides for a per capita volume of 3.5 cu ft based on population figures projected to the year 2000. Each tank has a diameter of 35 ft, a cone depth of 6 ft, and a sidewater depth of 21.5 ft. The primary tank is equipped with a fixed cover, while the secondary tank is equipped with a floating cover. Scum is broken up in the primary tank by the discharge of recirculated supernatant liquor through fixed nozzles positioned above the scum surface. The sludge is heated by recirculation through a combination heat exchanger boiler unit, which can be fired by collected sewage gas or fuel oil.

A control house connects the two tanks, and houses the sludge heating unit, sludge handling pumps, gas utilization equipment, as well as office, laboratory, and toilet space.

Although transfer of the digestion process to the separate heated tanks should reduce the volume of surface scum in the Imhoff tanks, a certain quantity will continue to collect. In order to provide year-round protection for the tanks, and still permit accessibility for periodic scum control and removal, brick superstructures were constructed on both Imhoff tanks.

In addition to the superstructures, the tops of the Imhoff tank walls were raised a height of 3 ft to prevent sewage flow from overtopping the tanks. Such a situation could develop during a period of high river level, when pumping of the effluent is required. Under such conditions a pump failure would result in sewage backing up in the Imhoff tanks. The higher tank walls will provide more time in which to open the plant bypass during such emergency.

With the provision of separate heated sludge digestion tanks and the revisions to the Imhoff tanks, the more critical problems of inadequate treatment and capacity were eliminated. Additional improvements, however, were in order.

The existing method of transferring sludge from the Imhoff tanks to the sludge drying beds was by a pneumatic ejector. To provide better control of the rate of sludge transfer from the converted Imhoff tanks to the new heated sludge digestion tanks, a plunger type sludge pump was provided. The pneumatic ejector was retained, however, as a standby unit.

Comminutor Furnished

The existing bar rack, although of ample capacity, presented operating problems. Raking was required frequently, with sloppy, foul-smelling rakings collected in barrels and truck-hauled to a dump. It was recommended that this unpleasant and time restricting opera-

AERIAL VIEW of Presque Island Sewage Treatment Plant.

tion be replaced with comminution equipment, with solids and rags automatically cut up and shredded. In accordance with the recommendation, a comminutor has been provided. In addition, a bypass rack was provided for use when comminution equipment is out of service or for times of abnormal sewage flow.

Grit Removal Included

Considerable amounts of grit are present in the Presque Isle sewage, a portion of which is derived from potato washing operations. Unless removed, the grit settles out in the bottom of the Imhoff tanks where it consolidates and becomes most difficult to remove. It is also likely that additional quantities of grit would settle out in the bottom of the heated digestion tanks, occupy valuable sludge storage space, and hinder the withdrawal of digested sludge. Elimination of these conditions was considered an important part of the rehabilitation design, and resulted in the provision of an aerated grit chamber. The unit is mechanically cleaned by a tubular conveyor. The removed grit is expected to be relatively clean and will be collected in easily handled metal containers and trucked to a disposal area to be used as fill.

Raw Sewage Water and Chlorination

With the existing treatment facilities, there was no available means for determining the quantity of sewage flow reaching the plant. Such data are extremely important to the evaluation and control of plant operations. Consequently, a 10-in. magnetic flowmeter was included in the design. The magnetic type unit was selected because of its compactness, low head loss, and freedom from clogging.

Chlorination facilities were also provided. A solution feed, vacuum type unit was furnished, arranged for program control or manual operation. The chlorinator has a maximum daily capacity of 200 lb/day, and can be modified to 400 lb/day in the future.

Weather Prediction

To insure proper maintenance, adequate weather protection for operating personnel was considered essential. Therefore, all operating facilities for the rehabilitated treatment plant were placed under cover. Accordingly, the flowmeter, comminution equipment and bypass rack, grit chamber, and chlorination facilities are contained in one structure. These facilities are arranged so that the flow of sewage can be gated to bypass any one or all of these units.

Future Possibilities

A further increase in the capacity of the rehabilitated plant is tentatively planned for the future, at such time when average sewage flows have increased to the point where the converted Imhoff tanks are once again approaching an overloaded condition. This would be accomplished by removing the original baffles in the tanks and installing mechanical sludge collecting equipment. In this manner the capacity of the present sludge hoppers could be added to the settling capacity.

Federal and State Grants Provided

Consolidated Constructors, Inc. of Portland, Maine, were the general contractors for the project and were awarded the contract for a bid price of $361,000. (A construction grant of approximately $110,000 will be given by the U.S. Public Health Service, and approximately $70,000 by the Maine Water Improvement Commission.) Metcalf & Eddy of Boston were the engineers; Mr. Edwin B. Cobb was partner-in-charge; Messrs. John Chalas and Howard B. Allen, project engineers; and Mr. Herman Kendall, resident engineer in charge of construction. Superintendent of the Presque Isle Sewer District is Mr. Douglas Dingwall.

Greater Vancouver Sewerage and Drainage District

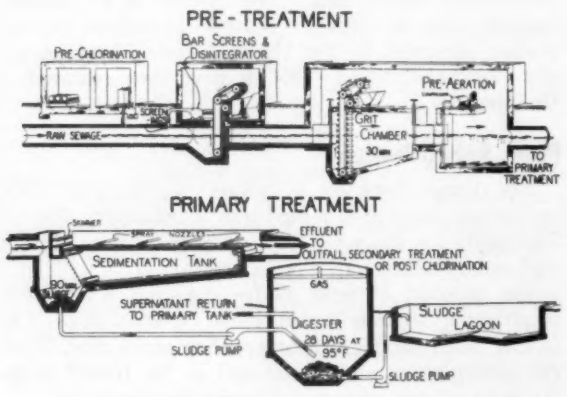
One of the most complicated design projects yet commissioned by the Greater Vancouver Sewerage and Drainage District will begin to pay dividends in late 1962 when the $11 million Iona Sewage Treatment Plant is completed.

The plant and its appurtenant works will be a model of a self-sufficient operation. Sludge gas produced from the plant's sludge digesters will fire the engine which will operate the plant. It is anticipated that only some 18 men will be needed for 24-hour operation and maintenance.

In its final form, the plant will serve Vancouver City, the University Endowment Lands and a westerly portion of Burnaby to at least the year 2000. It is designed to grow with the needs of the city until it eventually handles a peak flow of 340 mgd from a tributary population of 640,000 people.

Because the basic trunk collection system of the Vancouver area carries both sanitary and storm water flow, the plant had to be designed large enough to handle this combined flow, particularly for wet weather peaks.

The first stage, now under construction, will serve up to 320,000 people. As new trunk mains are built to bring in the sewage of a wider area, the extension from initial to ultimate design can be accomplished with the duplication of sedimentation and digestion tanks and their appurtenant equipment. Other principal machinery for the final design will be installed in the first stage.



RESEARCH PROGRESS REPORT

Bioassays Determine Pesticide Toxicity to Aquatic Invertebrates

by ARDEN R. GAUFIN, Assoc. Prof., LOREN JENSEN, and THOMAS NELSON, Grad. Students, Dept. of Zoology and Entomology, Univ. of Utah, Salt Lake City, Utah

■ THE GREATLY EXPANDED use of organic insecticides during the last fifteen years has created new problems in water pollution. There now are more than 100 synthetic organic insecticides on the market and these are available in thousands of different formulations. More than 30 million acres of cultivated cropland alone are sprayed each year in the United States. The treatment of forests and highway rights-of-way is adding to the total use of insecticides and herbicides. In addition, the chemical control of mosquitoes, rough fish, and aquatic vegetation is increasing.

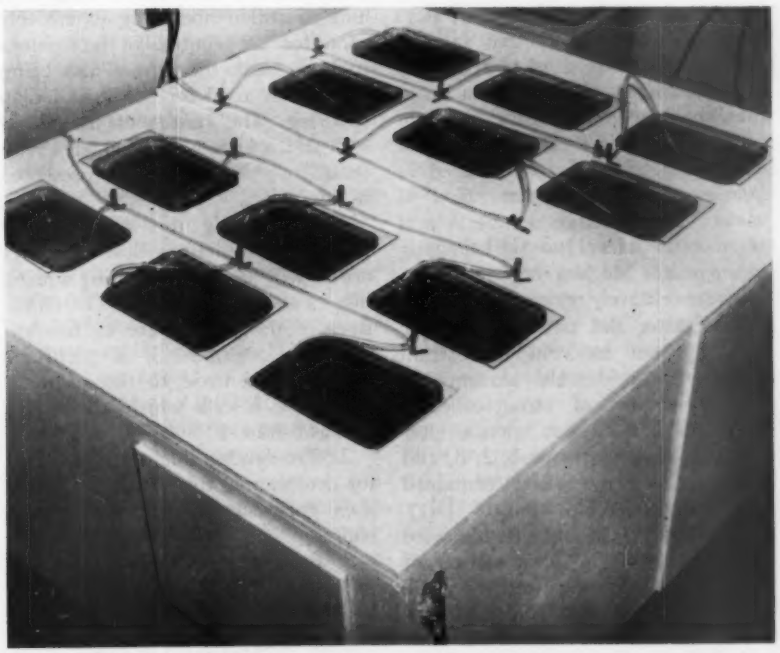


Fig. 1. APPARATUS FOR conducting static bioassays.

Toxicity to Aquatic Life

With over 500 million pounds of organic pesticides being broadcast over the land each year, it is inevitable that some of it will reach our water courses in concentrations which are toxic to aquatic life. Many of these materials have a long residual toxicity in the soil. Analyses of samples taken in connection with several U. S. Public Health Service investigations have shown the presence of insecticides in our major rivers. For example, concentrations of DDT as high as 5 to 20 parts per billion have been reported in the Detroit, Missouri, Mississippi and Columbia rivers. Numerous fish kills have been reported. Other aquatic life making up the food chain of fishes has been wiped out.

Large scale application of some insecticides, such as those used in forest spraying, cotton dusting, and mosquito control may cause wide-

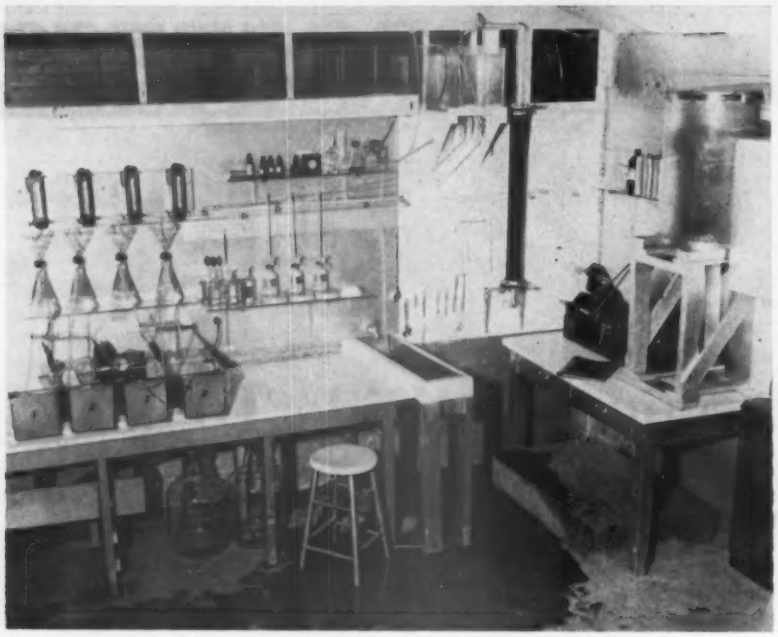


Fig. 2. APPARATUS FOR conducting continuous flow bioassays.

spread destruction of aquatic life. Several such incidents, involving chlorinated hydrocarbon insecticides as DDT, have already occurred. In the summer of 1955 a considerable area of forest along the Yellowstone River was sprayed with DDT in oil at the rate of one pound per acre to control spruce budworm. An estimated 99 per cent of the aquatic insects along a 100-mile section of the stream were killed. Losses of trout, whitefish, and suckers appeared in early October, three months after the spraying. It is belived that many fish died of starvation, because of the high mortality of aquatic insects caused by the spraying.

Forest spraying in Canada at the rate of one pound of DDT per acre to control spruce budworm has also caused definite although temporary losses of invertebrates. Rudd and Genelly[8] reported that in quiet water, submerged forms seemed to be little affected, whereas in rapids larvae and insects were almost completely destroyed.

The comprehensive studies of Hofman[6] and his co-workers have provided considerable data as to the toxic effects of forest spraying practices on aquatic organisms. Two watersheds in Pennsylvania were sprayed with DDT in oil at one pound per acre for the control of gypsy moth. The status of aquatic insects was studied intensively within the sprayed area and in comparable control streams. Over 94,000 bottom insects were examined. Population studies were made before and at intervals after spraying in order to determine both the immediate and longer term effects.

Bottom samples supplemented by drift samples indicated that from 70 to 90 per cent of the stream bottom insects were eliminated within 3 days after the spraying. Bottom samples taken near the mouths of creeks or their tributaries showed greater losses than those taken upstream. Trichopterans, or caddis flies were the most affected, being seriously reduced in numbers. They were not taken in variety and in large numbers until 16 months later. Insects belonging to the orders Megaloptera and Odonata were relatively resistant.

The water did not remain toxic for long, but moss in the stream contained considerable amounts of DDT. Samples of moss collected from one stream one month after spraying at distances of 1, 2, 3, and 6 miles from its source contained 0.44, 110, and 128 ppm of DDT respectively. These amounts indicated that there was an accumulation of DDT from the headwaters to the mouth of the stream, and may have accounted for the mortality of fish and fish food organisms observed for a month after spraying.

In the aquatic habitats studies there were seven orders of bottom insects collected. This bottom life, although sharply diminished for 1 to 2 months, was never completely eradicated at any of the sampling stations. By the third month after spraying the trend toward recovery of the population was general. Within less than a year the aquatic insects in the streams of both sprayed watersheds equaled prespray numbers.

Objectives and Scope of Research

While there have been some excellent studies evaluating the comparative toxicity of some of the new insecticides to fish, information as to the effects of most of these compounds on aquatic invertebrates is still limited. With the expanding use of insecticides there is a marked need for comprehensive studies by entomologists, fishery biologists, and chemists to determine both the immediate and long term effects on aquatic life. In order to determine the possible effects of some of the insecticides in current use in the Intermountain Region on aquatic life in the streams and lakes of the area, the author initiated a series of toxicity bioassays at the University of Utah early in 1959. While many different toxicants will be tested in the future, only those insecticides of most common use in the region have been tested to date. DDT, malathion, and parathion are being extensively used for the control of mosquitoes in Utah, with the former also being extensively used for forest and crop spraying. The results of the bioassays which have been completed with these insecticides will be presented in this report.

In conducting this project both static and continuous flow bioassays are or will be employed using aquatic insects as test organisms. The objectives of the project are as follows:

1. To determine if a particular insecticide is toxic to those species of aquatic insects which are important as fish food.

2. To develop bio-assay methods for determining the toxicity of chemicals or wastes to fish food organisms.

3. To determine the level of toxicity under conditions of short and long time exposures and safe levels for certain periods of exposure.

4. To determine the relative tox-

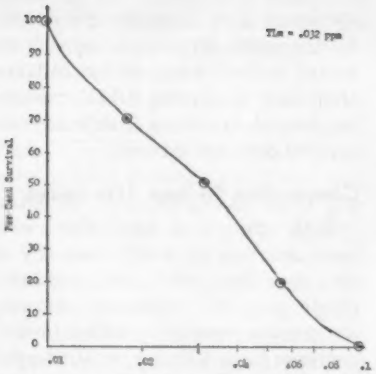


Fig. 3. PERCENTAGE OF SURVIVAL of *Arctopsyche grandis* exposed to malathion.

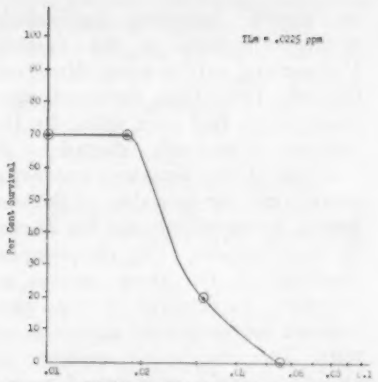


Fig. 4. PERCENTAGE OF SURVIVAL of *Hydropsyche californica* exposed to malathion.

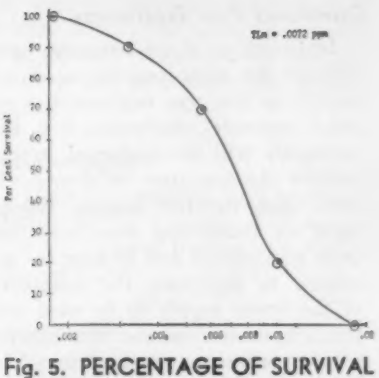


Fig. 5. PERCENTAGE OF SURVIVAL of *Acroneuria pacifica* exposed to malathion.

icity of insecticides to fish and fish food organisms.

5. To determine how the toxicity of various insecticides varies with changes in water quality characteristics.

Bioassay Methods

Bioassays are being conducted by the method recommended by the toxicity subcommittee of the Federation of Sewage and Industrial Wastes Associations[2]. The method consists of preparing various concentrations of insecticide in a selected dilution water, adding the test invertebrates, and observing their reactions for a definite time. For ease in plotting and interpreting the results it is desirable to make up test solutions with concentrations (ppm) of the chemical in a logarithmic series as 10, 5.6, 3.2, 1.8, and 1.0.

Because the insecticides which have been used were of unknown toxicity, exploratory small scale tests were made to determine the approximate toxic range. Test solutions were prepared over a wide range of concentrations, such as 100, 10, 1.0, 0.1 ppm. Ten insects were added to three liters of each concentration in 2 gallon aquaria. Aquaria, constructed of all glass and measuring 11″ x 7″ x 6″ each, were used as containers for the experiments. Observations for 24 to 48 hour periods were made to determine concentrations necessary for the full scale tests. The intermediate concentrations tested were dependent upon data obtained from exploratory tests. For example, if the insects were killed by 1.0 ppm and not in 0.1 ppm, intermediates were set up within this range, eg. 1.0, 0.56, 0.32, 0.18, and 0.1 ppm of insecticide.

Hard water from Millcreek, a cold mountain stream located near the University of Utah, was used for dilution water. Water from this stream is very similar chemically to that in the streams from which the test organisms were collected. The water was allowed to come to near the test temperature before it was used. At the time of use for bioassays the average characteristics of this water were as follows:

DO	8.5	ppm
pH	8.3	
Alk. as $CaCO_3$	8.0	ppm
Alk. as $Ca(HCO_3)_2$	151.0	ppm
Silicon	9.5	ppm
Nitrates	0.12	ppm
Phosphates	0.32	ppm

Species Tested

The aquatic insects used as test species were three species of stoneflies, *Acroneuria pacifica* Banks, *Pteronarcys californica* Newport, and *Claassenia sabulosa* Banks, and two species of caddisflies, *Arctopsyche grandis* Banks, and *Hydropsyche californica* Banks. These forms were selected for use because they occur commonly in streams near Salt Lake City, they constitute an important source of food for trout, they can be kept alive readily under laboratory conditions, and both groups were reported in the literature to be sensitive to exposure to DDT employed in forest spraying.

The five species used are all characteristic inhabitants of clear, cold, well aerated mountain streams in the Intermountain Region. After they were collected, all specimens were acclimated to laboratory conditions for at least one week before they were used for bioassays. In order to keep them alive in the laboratory, the water temperatures in the retaining aquaria had to be kept below 60°F, the water had to be constantly agitated or aerated by introduction of compressed air, and small irregular rocks had to be provided as a substrate for attachment. Specimens used in the bioassays ranged in length from 2 to 5 cm.

Test Apparatus

The test aquaria were suspended in two 50-gal refrigerated water baths. The temperature of the water baths and in each aquarium was controlled at 52-53°F. Inasmuch as all five species of insects used in the tests require well aerated running water, aeration of the test solutions had to be provided. Compressed air was introduced into each container by gas dispersion tubes. A glass cover on each aquarium prevented the escape of dissolved volatile substances.

Chemical analyses (DO, pH, alkalinity, acidity, and often nitrates and phosphates) were made on each test concentration initially and at the completion of the test. The reactions of the specimens were observed over a 96-hour period. From the mortality in different concentrations, 24-, 48-, and 96 hour TLm (median tolerance limit) values were obtained. The median tolerance limit is the concentration of chemical in dilution water that kills 50 per cent of the test organisms. These values were obtained by straight line graphical interpolation from points representing per cent survival of the organism and log concentrations of insecticide formulations which bracketed the 50 per cent point[2].

Continuous Flow Experiments

Inasmuch as static bioassays only indicate the acute toxicity or direct injury to the test organisms upon short exposure, continuous flow experiments will be conducted to determine the long-time or chronic effects upon the test insects. Equipment for conducting these tests has been constructed and is now in operation to determine the suitability of the water supply to be used and the adaptability of the test species to the experimental conditions. In conducting the continuous flow tests properly conditioned dilution water will be pumped into stainless steel troughs containing specimens of particular aquatic insects. The tests conducted to date have shown the need for removing iron oxide and excess carbon dioxide from the well water which will be used as dilution water. A carbon filter is being constructed for this purpose.

The flow of dilution water will be measured by means of suitable sized rotameters and micro-metering valves. A solution of the insecticide to be tested will be mixed with the dilution water in various concentrations, such as those used in the static tests, before the water will be pumped into the test chambers. A laboratory metering unit consisting of a ¼ HP motor, gear box, and 3 smaller pumps capable of pumping 1 ml. of solution per minute will be used for pumping and measuring the insecticide solutions. The experimental apparatus for conducting the continuous flow bioassays is shown in the accompanying pictures.

Bioassay Results

The adaptability to laboratory conditions of the different species which have been tested and consequently their suitability as test organisms has been quite variable. The caddisflies, *Arctopsyche grandis* and *Hydropsyche californica* were both highly susceptible to the fungus, *Saprolegnia* when maintained at 65° F in the holding tanks. The three species of stoneflies were not susceptible to this infection even when in association with affected caddisflies. Caddisflies also were susceptible to mechanical injury during handling. The stoneflies proved to be hardier in this respect.

Cannibalism among the stoneflies in the exposure tanks was observed on several occasions, particularly among members of the species, *Pteronarcys californica*. However, the only individuals devoured were those which had been killed by the toxicant or seriously affected by it.

In all of the bioassays conducted except one, the mortality of the test species increased between the 24 and 96 hour periods. The physiological reactions of the three species of stoneflies particularly were pronounced but somewhat similar in all tests. The first visible evidence of an effect was a pronounced period of excitability in which the stoneflies crawled about rapidly but with little or no loss of coordination. This behavior was in distinct contrast to that of specimens in the retaining aquaria or in the control. When not exposed to an insecticide the stoneflies remained hidden from view, resting or crawling about slowly under the rocks in the aquaria.

The second reaction involved a loss of coordination in which short jerky movements and a partial loss of equilibrium became evident. Finally, the affected individuals lost their balance completely and came to rest on their backs on the bottom of the aquaria. This reaction, however, was not necessarily followed by death, but rather many specimens when removed from the aquarium would vibrate their appendages, the rate depending on the strength of the toxicant to which they had been exposed. These tremors were often displayed for 24 to 48 hours before death ensued.

A considerable size differential in sensitivity was found to exist in all of the species tested. This was particularly evident in *Pteronarcys californica*. Specimens 4 to 5 centimeters in length were resistant to five times the concentration of DDT as specimens 2 to 3 centimeters in size. Furthermore, larger specimens if removed to fresh water within 24 hours after first displaying DDT tremors, on several occasions completely recovered their equilibrium.

Comparative 96 hour TLm values

Both species of caddisflies were more sensitive to DDT than any of the stoneflies, with the caddisfly, *Hydropsyche californica*, showing the greatest sensitivity with a median tolerance limit (TLm) of 0.048 ppm. The TLm values for the other test organisms ranged from this low concentration to a high value of 0.56 ppm for the stonefly, *Pteronarcys californica*. In descending order of sensitivity the respective median tolerance limits to DDT of the different test organisms was as follows:

Most sensitive	*Hydropsyche californica*	.048 ppm
	Arctopsyche grandis	.175 ppm
	Acroneuria pacifica	.41 ppm
Least sensitive	*Pteronarcys californica*	.56 ppm
Most sensitive	*Acroneuria pacifica*	.0072 ppm
	Hydropsyche californica	.0225 ppm
	Arctopsyche grandis	.032 ppm
Least sensitive	*Claassenia sabulosa*	.056 ppm
	Pteronarcys californica	.1 ppm
Most sensitive	*Hydropsyche californica*	.00043 ppm
	Acroneuria pacifica	.001 ppm
	Arctopsyche grandis	.007 ppm
Least sensitive	*Pteronarcys californica*	.0086 ppm

Malathion, however, was most toxic to *Acroneuria pacifica* and least toxic to *Pteronarcys californica* with the other species displaying TLm values in the intermediate range. In descending order of sensitivity the TLm limits for malathion were as follows:

The studies with parathion showed that this insecticide is much more toxic than the others tested. *Hydropsyche californica* again was killed by the lowest concentrations and *Pteronarcys californica* was the least affected. The respective TLm values were as follows:

In order to determine the median tolerance limits for the various insecticides the per cent survival of the test organism was plotted on the arithmetic scale and the concentration of the insecticide, in ppm, on the logarithmic scale of semi-log paper. A smooth curve was then fitted to the points and the concentration value at which this curve crossed the 50 per cent survival line was

taken as the TLm. The graphs in Figures 3 through 5 illustrate the results for three of the bioassays involving malathion.

The stock solutions of insecticides used in the bioassays were prepared from concentrates formulated with xylene as a solvent. The DDT and parathion concentrations were prepared from technical grade material at a concentration of 2 lbs per gallon of solvent which yielded a 25 per cent emulsion of active agent. The malathion concentrate contained 57 per cent of active agent and was formulated by the addition of 5 lbs per gallon of solvent.

Bioassays were also conducted with xylene and the emulsifier used in the preparation of the respective concentrates in order to determine if the toxicity was entirely due to the three different insecticides being tested. Concentrations of xylene and the emulsifier as low as 100 ppm were toxic to *Arctopsyche grandis, Acroneuria pacifica* and *Pteronarcys californica*. Concentrations of the emulsifier alone were toxic at 180 ppm. Concentrations of acetone, another commonly used solvent, up to 320 ppm had no effect on the test species.

A comparison of the toxicity of DDT, malathion, and parathion to the species tested with data reported for *Daphnia magna*[1] indicates considerable variability. He reported the tolerance limits for that species of crustacean to be less than 1 ppb to DDT, 0.9 ppb to malathion, and 0.8 ppb to parathion. The lethal levels reported were for 48 or 64 hours. Thus *Daphnia magna* is over 180 times as sensitive to DDT as *Acroneuria pacifica*, 100 times as sensitive as *Pteronarcys californica* and *Arctopsyche grandis* but only 10 times as sensitive as *Claassenia sabulosa*. Malathion is similarly much more toxic to Daphnia but parathion is only one-eighth as toxic to Daphnia as it is to *Acroneuria pacifica*.

A comparison of the toxicity of DDT to stoneflies with previously reported values for fish again reveals considerable variability. Fathead minnows, bluegills, and guppies are more sensitive to DDT than two of the three species of stoneflies tested, but goldfish are much less sensitive. On the other hand, the stoneflies tested are 100 to 2,500 times as sensitive to malathion and 200 to 7,000 times as sensitive to parathion as bluegill and fathead minnows.

The TLm values discussed in this paper should not be considered as safe concentrations for all bottom fauna in fast moving streams. These values are concentrations which will kill 50 per cent of the test species upon relatively short time exposure. Different formulations of the insecticides, and the many variable ecological factors existing in any stream would undoubtedly alter the results. The values given, however, do constitute a valid comparison between the relative toxicity of the insecticides tested and the sensitivity of the experimental species.

It would be unwise to make any conclusive generalizations concerning the toxicity of the compounds tested until considerably more research is completed. Further experimentation is needed to determine the toxicity of these and other pesticides to various species of aquatic invertebrates at different stages in their life histories. Conditions under which the toxicity may differ in both the laboratory and field also need investigating.

Acknowledgment

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Literature Cited

1. Anderson, B. G.
Environmental requirements of Daphnia and other invertebrates. Second seminar on Biological Problems in Water Pollution. R. A. Taft San. Engr. Center, April 21, 1959.

2. Doudoroff, P., B. G. Anderson, G. E. Burdick, P. S. Galtsoff, W. B. Hart, R. Patrick, E. R. Strong, E. W. Surber, and W. M. VanHorn.
Bioassay methods for the evaluation of acute toxicity of industrial wastes to fish. Sew. and Ind. Wastes, **23**:11 (1951).

3. Henderson, C., and C. M. Tarzwell
Bioassays for control of industrial effluents. Sew. and Ind. Wastes, **29**:9, (1957).

4. Henderson, C., and Q. H. Pickering
Toxicity of organic phosphorus insecticides to fish. Trans. Amer. Fish Soc., **87**, (1957).

5. Hoffman, C. H., and A. T. Drooz
Effects of a C-47 application of D.D.T. on fish food organisms in two Pennsylvania watersheds. Amer. Midl. Nat., **50**:1, (1953).

6. Hoffman, C. H.
Are the insecticides required for pest control hazardous to aquatic life? Second seminar on Biological Problems in Water Pollution. R. A. Taft San. Engr. Center, April 21, (1959).

7. Krause, Keith S.
Pollution abatement. Water resources activities in the U.S. Committee print no. 9, select committee on national water resources, U. S. Senate, pp. 1-38.

8. Rudd, R. L., and R. E. Genelly
Pesticides, their use and toxicity in relation to wildlife. Game Bull. no 7, Calif. Dept. of Fish and Game, pp. 1-209. (1956).

9. Tarzwell, C. M. and Henderson, C.
Toxicity of dieldrin to fish. Trans. Am. Fish. Soc., Vol. **86** (1956).

Pittsburgh Uses Membrane Filter Inspection Technique

Pittsburgh, Pa., has adopted the "membrane filter technique" for bacteriological inspection of the city's water supply.

According to John A. Murphy, director of the Water Department, the technique has been in use since March 15 and has provided a faster, more accurate daily check on the quality of the city's water.

Equipment in the membrane filter examination of water for bacteriological content was supplied by General Ionics Corp.

Use of the system has reduced the time necessary for accurate evaluation from 48 to 96 hours down to 18 to 22 hours. The system has also reduced manpower requirements and cut evaluation costs. Mr. Murphy also reported "increased reliability of control over treatment of water."

Callison Appointed To Water Pollution Board

Charles H. Callison, nationally known conservation leader and officer of the National Audubon Society, was appointed to the Water Pollution Control Advisory Board by the President on June 16, 1961.

Under the direction of Dr. Luther L. Terry, the Board gives advice to the Surgeon General on the administration of the Federal Water Pollution Control Program, a cooperative service of the Public Health Service and the separate states, municipalities and industries. The program involves the problem of maintaining an adequate quality and quantity of water.

Municipal waste treatment plants, with the help of P. L. 660 for Federal aid, have increased by 62 percent since the passage of the bill. Even with the ratio of monies spent by localities to that spent by the government being 5 to 1, the government has granted $220.5 million to 2687 communities.

Local Officials Can Improve a Water System

by STEPHEN C. CASTEEL
Water Utility Service
Belleville, Illinois

■ WHEN ATTORNEY Henry A. Schwarz was elected Mayor of O'Fallon, Illinois, in 1957, he immediately directed his attention to the Water Department and its problems. The new Mayor was somewhat familiar with the Water operation. He was, therefore, aware of the importance of good operation, both as to revenue and the opportunity for improved service to consumers at reasonable rates. Elected with the Mayor as Aldermen were several business men who shared his view that all branches of the municipality should be studied for operational improvement, especially the Water Division.

The town of O'Fallon, Illinois, population 4,000, is located some twenty-five miles east of St. Louis, Missouri. In addition to being the trading center for the large surrounding agricultural area, it has over the past decade experienced a rapid residential growth in and out of the city. This is caused by the desire of many families in the metropolitan center to have their homes in a good suburban section and still be within easy driving distance from their jobs.

The service area of the water department extends eight miles westward from the corporate limits, and about 65 per cent of the consumers reside in this section of the system. The department serves an estimated total population of 12,000. The town has had a Water Supply system since the early 1890's. In 1929 substantial additions were made in order to abandon the well supply, and a contract was entered into with the East St. Louis and Inter-urban Water Co. to purchase treated Mississippi River water. In order to accomplish this, a 10 in. cast iron pipe line, eight miles in length, was installed along U. S. Highway 50 to reach the East St. Louis system. After this installation was completed, new subdivisions developed on both sides of the highway, and since 1948 this growth has been pronounced. In 1950 it was necessary to supplement the 10 in. pipeline with the installation of 17,000 feet of 12 in. asbestos-cement pipe and a 0.5 mg. storage tank.

In 1957, when the new administration took office, it immediately proceeded to provide a modern office on the ground floor of the City Hall. A room was completely remodeled, and a counter was provided, with the necessary accessories, that befit an operation of this size. It then decided to obtain the service of an experienced water works operator to assist in a study of the methods used in the system and to submit reports and recommendations for improvements. The official statement read: "We want to know what can be done to make this operation comparable with the accepted standard of good water works practice."

Survey

Survey was started with the complete cooperation and assistance from the elected officials and the employees. It was soon found that the routine office work handled by the City Clerk and one full-time girl was becoming too much in this rapidly growing system, with 3,000 accounts. In a water office of this size where collections are handled along with other routine work, sufficient time must be allocated to customer contacts, which, of course, is an important phase of the business. With the available time and the few forms required, properly filed, the collections can be made and recorded with dispatch, which in turn can engender much good will with those paying the bill. The intention was to conserve time rather than add to the work force. The time-consuming and monotonous operation of addressing 1,000 bills each month was eliminated by the installation of an addressograph with the necessary accessories for plate making, etc. The billing is on a quarterly basis, one-third of the accounts are billed each month.

Table I
Pipe in System—1957

	Total Feet	% Two Inch Pipe or Under
In City	73,432	26
Out of City	174,129	73

For meter reading and billing purposes, the system was divided into three divisions, designated as A-B-C, each division with six to seven meter books. One division is read and billed each month. At the time of setting up the divisions with new meter books, each service was assigned a number in addition to the account number for the purpose of establishing a service record system. A size 10 manila envelope, with the service number stamped thereon, is provided for each account. These are filed vertically in numerical order in a cabinet, a conventional practice at many places. All information pertaining to a particular service is filed in the proper envelope; thus maintaining a historical record of each service, which is most essential and convenient in day to day operation. After such a record is established and in use, it is surprising to note the time saved in handling customer complaints because the record of the service is readily available in the envelope.

The use of several forms was started, such as Service Order, Tap Order, Monthly Water Use Report, etc. The application of the revised methods reduced the amount of routine office work, and the records facilitated the prompt handling of any matter that arose.

Meters

A careful study of all meters was made, the make, type, when installed, and if in proper working order. Each account was analyzed as to consumption over several quarters. This resulted in replacing some 400 defective meters. Plans are now being made to set up a schedule for testing all meters that have been in service ten years.

Capital and Operating Discounts

An inventory of all property in the system was made. The replacement cost was estimated and accrued depreciation computed. The account-

ing system was revised to separate the capital and operating expenditures, and it is functioning in accordance with accepted practice.

Extensions Regulated

The system, typical of so many, has had a considerable growth, especially over the past 12 years. Much of this growth occurred along the eight-mile supply line outside the corporate limits due to subdivision development. Pipeline extensions were installed by developers with little or no attention to adequacy or to future requirements, resulting in a preponderance of 2 in. pipe, as shown in Table 1. A casual study of this situation pointed to the obvious necessity for revision of the method of financing extensions.

To provide a more adequate distribution system, as well as considering future growth, the City issued the following rules:

1. No 2 in. pipe to be installed.
2. No galvanized pipe to be installed.
3. Developers will submit a plan to the City before development.
4. The City will specify the size of pipe and estimate the cost of installation.
5. The Developer will deposit with the City the estimated cost of the installation.
6. The City will arrange for and supervise the installation.
7. Refunds will be made to the depositor on the basis of two times the revenue for the first year of each customer if out of the City; and two and one-half times if in the City.

This, of course, is the most equitable method of providing extensions to a distribution system. It is the intension that no pipe less than 6 in. shall be installed. This ruling has been in effect since April, 1959, and has proved acceptable and satisfactory to all concerned.

Expenditures and Rates

In the three years since the administration took office over 500 new customers have been added. During this period over $100,000 have been spent for additions to the system, and $52,000 paid on the bonded debt. This has been accomplished with a very reasonable rate structure as compared with other communities of comparable size in the area. The following tabulation is taken from an analysis of all customer accounts for the three quarters ending May, June, July, 1960.

Table 2
Consumption Analysis

Range	Minimum quarterly $7.50 for 10,000 gals. Rate 1000 gals.	No. Accts.	1000 gals. Used	% of Total	Revenue	% of Total
To 15,000 gals.	$0.75	2744	24,064	43.4	$21,829.45	55.5
Next 15,000 gals.	0.60	670	13,581	24.4	9,640.40	24.4
Next 72,000 gals.	0.50	124	5,547	9.8	3,429.25	8.7
Next 300,000 gals.	0.40	7	1,460	2.6	731.50	1.8
Next 750,000 gal.	0.35					
All Over	0.28					
Total Quarterly		3545	44,652	80.2	$35,630.60	90.4
Monthly Industrial		11	11,045	19.8	3,774.67	9.6
Grand Total		3556	55,697	100.	$39,040.27	100.

The largest of the monthly accounts classified as industrial used an average, per month during the period studied, of 2,500,000 gallons. The second largest used 1,500,000 gallons. The remaining nine used a varying quantity down to a low of 100,000 gallons per month. At the lower end of the rate structure, 1872 customers were in the minimum range (10,000 gallons or less per quarter). The average use per quarter was 6,900 gallons. This classification used 23% of the water sold and produced 35% of the gross revenue.

In lieu of taxes, which would be incumbent on a private operation, free service is extended to 90 fire hydrants, a modern swimming pool, all municipal buildings and parks.

The water plant here described is a distribution operation, consisting of pipelines, elevated tank, ground storage tank, and a booster pumping station. It is, of course, well known that much preventable loss can occur in a delivery system (pipelines, services, and meters). It is to this matter that the efforts of the elected officials have been directed over the past three years, and the results have been very worthwhile.

Summation

A brief description of the items covered follows:

1. The depreciated value of the system established.
2. Sufficient office equipment provided to facilitate the work.
3. Simple records and forms put in use, including a complete service record filing system.
4. Meter reading routine revised by setting up divisions, etc.
5. Accounting method revised to separate Capital and Operating Expense.
6. The plan for financing extensions revised.

What has been accomplished in this public water system in a relatively short period of time is ample proof of what can be done by a dedicated and aggressive administration. We hear a great deal regarding the shortage of water in some places. One of the principal contributions to water shortage is, of course, the neglect of metering. A defective meter or no meter on an account denotes an inefficient operation, and it serves no useful purpose to the supplier or to the customer. The importance of a properly metered system, and all meters read promptly and correctly at stated intervals cannot be over-stressed. The neglect of this phase of the industry is difficult to comprehend in the light of so much information on the subject. This problem, as well as others encountered in the industry, can best be solved by those directly connected with the operation in a particular locality. They know the town, its people, its problems, the resources and facilities at hand. A complete study of all phases of the system is desirable. However, to obtain the ultimate results after the study is made requires the interest, attention and direction of the local administration.

This was the method used at O'Fallon, Illinois. Mayor Schwarz, his Board of Aldermen and the City Clerk have, by concentrated effort, provided their town with a well managed water department. They have plans well projected into the future for keeping the water systems geared to meet demands imposed by additional population growth.

Partially Oriented on . . .

Take One, Scene Two

■ IT HAS NEVER been my intention to be a photographer; much less has it ever been my intention to become a film star. Yet in the profession of civil engineering it seems frequently necessary to be both. Mind you, I am not so bad with a camera. I have managed to annoy several of my friends with it by putting their unguarded moments on record. But as a film actor I am no good at all. I shall never be more than a watery-eyed statue squinting at the sun. This, however, makes not the slightest difference to official site photographers who track me down on a construction site bent on getting some kind of 'human interest' to their otherwise dull and pasty pictures. "Would you mind, Sir, just standing over there for a moment," flatters the photographer. I stand transfixed for the moment, where the remark has caught up with me in semi-flight. "Well no Sir, perhaps not just like that; couldn't you be *doing* something . .?"

Doing what, I think to myself. Good gracious what on earth do civil engineers *do* anyway. "Couldn't you take up a spade, Sir," suggests the photographer. "What me!" I reply in astonishment. "Well, Sir, perhaps you could be directing those workmen over there." I look around. Two grinning workmen are resting on their spades knee-deep in a pit. "Friend," I say to the photographer, "those men do not come under my control, they come under the Foreman. If I start ordering those men around, that little black cloud on the horizon there, which *is* the Foreman, will grow into a big black cloud taking the light out of your lens. Ask them yourself."

"Say you chaps," says the photographer, "couldn't you be digging that pit?" The photographer, innocent that he is, imagines the men are not digging the pit. If he knew anything at all about civil engineering he would know that workmen never dig holes; they simply cause holes to appear by standing about in them and perpetrating some subtle trick of conservation of energy unknown to Newton. If these men are persuaded to give some visible signs of digging a pit they will probably flay into the job with such stunning abandon that, when that bit of film comes onto the screen, tears of laughter will be brought to the eyes of a technical audience.

What are they digging the hole for anyway? It really is too much; no sooner do we make a bit of progress on this job than someone starts throwing it all up again. The photographer is waving violently—"Yes Sir. You stand on the edge of the pit and point at it. Hey you! Look up when the boss is speaking to you." I hiss at the workmen through my teeth—"What on earth is this hole for; how deep is it going to be? Good heavens, how many times has this been happening . . .?"

"O.K." says the photographer, "now I'll take a shot of you over there." "What, over there!" I reply, "You can't take one of me over there —posterity doesn't want a record of all our misfortunes does it?" "Well it looks nice", says the photographer, "with all that water standing around and those rusty old . . . ." "Friend," I cut in, "if you want continuity of acting personnel on your film, turn your camera the other way. How would you like to be photographed knocking your camera over?" The photographer goes white. "Now how about a nice close-up of this piece of concrete here" I continue. "Too static" says the camera man, "You've got to bear in mind that I'm making a film for the general public. We've got to have Action that's of interest to old ladies and schoolboys."

"That's all very well," I say, "but you are never around when anything happens. You missed the time the crane fell into the basement; you missed the time a lorry pushed the foreman's hut through the stores; you've missed half a dozen pile-ups of lorries; and worst of all, the only time anyone fell into the reservoir you missed that as well, because it was you who fell in. Why don't you bring a stunt man with you if you want some action?" "Never mind," I say, noticing his dejected look, "I'll take you up to the quarry. We're blasting there at 12 o'clock."

We lie in wait at the quarry, watching from a safe distance. The photographer adjusts his camera with fidgety niceness. "What are those men doing there?" he says excitedly. "Nothing" I reply. He sighs and says ungrammatically—"Nobody does nothing on this job—what are they there for then?" "To prevent the likes of you and other ignorant strangers getting their heads blown off," I reply. The charges go off. It is a good firing, nicely timed, and within a jiffy the quarry has sprung to life again. "Good gracious! Is that all?" says the photographer disgustedly, "Why nothing happened! Where's the landslide; where's the explosion gone to? Why—there wasn't even a stone went up in the air!"

"Just so," I reply, "that's exactly what I wanted you to film. This foreman does a marvelous job; not an ounce of shot wasted; no dust, just a gentle lift and there she is all broken up ready for digging. That's a 'shot' to be proud of." The photographer is still peering incredulously through his camera. "But" he says, "I can't make a film of a job like this, where nothing ever seems to happen. How the job gets done at all beats me."

"Ah well" I say, "that's your misfortune and I'm sorry to disappoint your thrill-seeking old ladies, but the trouble with us is that we are a well run job. We are nearly three parts finished now and, if all goes well, you'll have to wait until the opening ceremony before you can get any more pictures of people making fools of themselves. By the way, this film is meant to be a comedy isn't it?"

The photographer starts busily packing his kit away while muttering some remarks I am not quite able to catch. "Hey, don't go yet", I call after him as he starts to move off, "I've got some snaps for you back in the office, you might be interested in. I took them at the time you fell into the reservoir. They've come out rather well."

1960 Annual Reports

Auburn, Me.; Annual Report of Water and Sewage Districts

An all-time record was set in gallons of water pumped and in total gallons delivered to mains, in the Auburn, Maine Water District, according to the 1960 annual report.

The amount of gallons reached 840,028,000.

The total operating expenses was $84,855.13 and the district finished the year with a net loss of 7,829.88.

The Auburn Sewage District finished the year with a net income of $3,252.42 with a total operating expenses running to $52,390.42.

A total of 8,254 ft of sewer mains were laid during the year while new extensions in the Water District totaled 9,524 ft.

Industrial Water Use In Ohio Report; Ohio Water Plan Inventory

Almost 11 billion gallons of water a day is withdrawn for industrial purposes in Ohio, according to a recent report concerning the Industrial Water Use In Ohio.

Of this total, the report reads, over 3 billion gallons daily enter into manufacturing directly and over 7 billion gallons are required for thermal power generation used in part for manufacturing.

When this survey was made, according to the report, Ohio ranked first in the Nation in the use of fresh water self supplied by industry.

"Much can be done to aid in developing assured water supplies," C. V. Yongquist, Chief, Division of Water writes in the report,

"Gaging of streams on a continuous basis indicates where sufficient stream flow is available. It is also essential for the planning and designing of stream regulation."

"Underground water sources," he writes, "are not explored to the utmost." He adds that systematic exploration by drilling and geophysical methods could produce substantial and economical additions to present supplies.

"Continous chemical quality sampling and monitoring," Youngquist writes, "of both underground and surface waters are required for efficient water use and reuse."

Fairfax County Water Authority Annual Report

During the fiscal year 1959-1960 the sum of $526,805 was expended for construction of initial improvements, in the Annandale Water System, Annandale, Virginia, according to the Fairfax County Water Authority Annual Report.

A modern, mechanized system of customer billing, collecting and accounting was instituted during the year. At the same time, a cycle billing program was inaugurated to provide a more regular flow of revenues and a more uniform distribution of work. Approximately 24,800 bills, covering the sale of approximately 426 million gallons of water, were rendered during the year.

An estimated total of 418 million gallons of water was supplied during the year, or about 1.15 million gallons per day. There was an increase of about 0.05 million gallons per day over the previous year.

The current revenues, totaling $414,095, were $13,130 less than expected, and the current expenses, totaling $225,497 were $26,503 less than expected. The net revenues, totaling $188,598, were $13,373 more than expected.

Annual Report for the Board of Water Supply City and County of Honolulu

The City and County of Honolulu Board of Water Supply sold 20,991,000 gallons of water during 1960, according to the Board's 1960 Annual Report.

The Board served a population of 422,000 and had 72,136 water customers. The daily water consumption averaged 65.2 million gallons while the maximum daily water consumption was 85.3 million.

The operating revenues came to $6,486,408 and the operating expenses were $3,729,463.

There were 942 miles of water mains, 6,219 fire hydrants and the reservoir storage capacity was reported to be 63.2 million gallons.

Chicago Public Works Annual Report

Approximately $11.5 million was accomplished during 1960 on the Chicago Central District Filtration Plant contract work. This brings the total amount expended on this project to more than $64 million by the end of the year, according to the 1960 Chicago Public Works Annual Report.

Based on the estimated cost of $102 million, the project was 64 percent completed by year's end. Work is continuing in preparing plans and specifications for a number of other contracts required to complete the plant.

Work was done on a new Southwest Pumping Station and the Columbus Avenue Water Tunnel. The tunnel is 25 percent completed and the new station is 60 percent completed.

Considerable work was also accomplished during the year on alterations and new equipment installation for the existing pumping stations.

Eight new sewer contracts were awarded during 1960 for a total value of $7,750,000 providing for 10 miles of major trunk sewers. New sewers put in covered about 10 miles.

The population benefited directly by the 1960 contracts is about 105,000, increasing the total population benefited by the Auxiliary Outlet Sewer Program, begun in 1947, to 1,250,000 persons.

Plans for 1961 include about 13 miles of new sewers to be awarded at a cost of $14,675,000.

Seattle Water Department Annual Report

An all time record for a single day's consumption of 264 million gallons was recorded for the Seattle Water Department on August 8, 1960.

This was 7 million gallons greater than any previous maximum day,

according to the Department's 1960 Annual Report.

Metered water revenue was $5,921,042.81 and net income was $1,166,347.40; greater than 1959 by $155,526.45.

Operating expenses, depreciation and amortization amounted to $4,921,764.96, a reduction of $55,121.61.

Puerto Rico Aqueduct and Sewer Authority Reports Increased Revenues

The Puerto Rico Aqueduct and Sewer Authority reports revenues of $854,893 for March 1961 compared with $739,352 in March 1960, according to Juan Labadie Eurite, Executive Director of the Authority.

For the year ended March 31, 1961 total revenues of the Authority rose to $10,328,174 from $9,486,831 in the comparable 12-month period the year before.

Middlesex County, N.J. Sewerage Authority Annual Report

Operating expenses for the Middlesex County, N.J. Sewerage Authority for 1960 amounted to $987,807.60, according to the Authority's 1960 Annual Report.

The average sewage flow was 40.56 mgd.

The average chlorination feed was 41 parts per million for the year, requiring 13,600 pounds of chlorine a day.

There was an average BOD removal of 14.5 percent with figures for individual months ranging from 11 to 21 percent.

The average quantity of sludge barged to sea was 20,169 net tons per month, with an average concentration of 5.9 percent solids.

Little Rock Municipal Water Works Annual Report

The total water produced and processed in the Little Rock, Arkansas, Municipal Water Works was 717 billion gallons in 1960, according to the 1960 Annual Report. This was about 8.4 percent more than the last year due largely to favorable weather conditions.

The Water Works System gained 1,213 customers bringing the total to 39,290. The total population being served is estimated to be 199,899.

Water processed at the Filtration Plant reached a high record of 7.7 billion gallons or an average daily production of 21 million gallons.

Augusta, Me. Water District Annual Report

The average daily use of water in the Augusta, Maine, Water District was 3,383,000 gallons in 1960, according to the District's 1960 Annual Report.

About 9.33 percent of the water supplied came from wells, compared with 11.7 percent in 1959.

The District has been operating at a net loss approximating $20,000 per year.

In November, 1960 the Public Utilities Commission approved a schedule of rates which will increase annual revenue from about $172,000 to $209,000 which will eliminate deficits in operating and financing the system.

Delaware River Drainage Basin Report

A survey report concerning the Delaware River Drainage Basin has recently been released by the New York State Department of Health.

Physical and hydrological factors of the waters, usage of lands bordering these waters, past and present usage and the extent of defilement were studied during the survey.

The purpose of the survey is to determine and give consideration to factors upon which basis the waters of New York State are classified and assigned standards of quality and purity under the law.

The basin has a total population of 85,000 and the principal industry within the area is the processing of bulk milk for transportation to metropolitan areas and the manufacture of milk products.

The greatest use of the waters of the basin is by New York City, for domestic consumption, with the maximum diversion out of the basin now being 490 mgd. This volume is expected to increase by 310 mgd in the near future.

During average stream flows there is no evidence of significant pollution grossly affecting fish life in the upper Delaware Basin. During extreme low flows pollution of the water may cause potential hazards to fish and silt adversely affecting fishing potential of some main streams.

Dept. of Air Pollution Control, City of New York Annual Report

Major gains resulted in the fight for clean air in 1960 for New York City due to the increased activity of all units of the Air Pollution Control Department.

Most enforcement activities, according to the Department's Annual Report for 1960, were at record or near-record levels.

Control projects continued to be the major factors in preventing air pollution and further advances were indicated as research in automotive and incinerator pollution went forward.

Excessive Hair Affecting Racine, Wisc. Treatment

The 23rd annual report on the Sewage Disposal Plant and System in Racine, Wisc., cites hair as a major factor affecting treatment. Hair and hide trimmings accumulate in the digestors, necessitating frequent cleaning. The report also announces the amount of sewage treated as 7,038,175,000 gallons, or a daily average of 19,230,000, 60 percent over the designed capacity. Population equivalents were: 117,910 figured on suspended solids and 150,600 figured on biochemical oxygen demand. The reduction of suspended solids was 49 percent with 81 milligrams per liter in the effluent. The reduction of biochemical oxygen demand was 28 percent with 117 milligrams per liter in the effluent. The report stressed the need for planning additional facilities due to overload.

Editorial

Setback to Certification

The summer issue of "ISAWWA", Illinois Section, American Water Works Association's member publication, carried a report of the death of legislation which would establish mandatory water works operator certification in Illinois. Edward R. Healy, Vice President and Manager of the Northern Illinois Water Corporation, invited comments from those members who would favor such legislation. It was reported that the Illinois House Committee on Public Aid, Health, Welfare and Safety voted 18 to 6 on a motion recommending that the bill "do not pass".

This majority of House Committee members voting to kill legislation plainly in the public interest is disconcerting. Mr. Healy reported that opposition testimony had been presented by ten witnesses for organized labor. The consensus of the witnesses was that "the bill threatened their members with general, vague and unfair regulations". Offers from the Section's Committee to make certain amendments failed to secure labor's support.

It is difficult to conceive how legislation so closely allied with public health practices could contain "vague and unfair regulations". It is equally difficult to conceive how ten witnesses, for whom the legislative provisions were no doubt intended, could intentionally stifle this opportunity for growth and squelch a concrete format for improved public utility operation.

Presumably, the ten witnesses were operating personnel employed in Illinois water utilities. It is, therefore, clearly understandable that they would not want to submit themselves to "general, vague and unfair regulations", if indeed these terms accurately describe the slain legislation. ISAWWA's report does not detail the terms of the legislation, nor how many witnesses testified in favor of it. Certainly, the proposed legislation must have been conceived in good faith, with the public, the utilities and the employees' interests in mind.

Plans now are to attempt to develop compromise legislation to be submitted for consideration at the next session of the Illinois legislature. Illinois Section, AWWA members would do well to heed Mr. Healy's request to provide concrete evidence that the membership supports such a program and to participate actively in assuring passage.

Operator certification has been listed as one of the several AWWA national aims and objectives. As an objective it has not been conceived out of whole cloth by AWWA 'brass'. Certification has been declared by the membership as one of the things necessary to improve public health standards and to improve the status of water utilities generally. There is a long history of successful operation of certification programs. Certification has played its part in securing community recognition of the need for water and wastewater projects, retaining and advancing operators, and perhaps most important: providing assurance that operators in the various categories meet certain minimum requirements.

Having gained early and valuable experience under a mandatory certification program, this writer finds it difficult to understand why progress toward increased numbers of mandatory certification programs in this industry must be delayed.

V. W. Langworthy

The Third Sanitary Engineering Conference at Urbana, Ill.

■ DISINFECTION and Chemical Oxidation in Water and Waste Treatment was the theme of the Third Sanitary Engineering Conference held in Urbana, Ill. Theory and practice of chlorination and other procedures was considered by 155 attendees of the series sponsored jointly by the Department of Civil Engineering of the University of Illinois and the Division of Sanitary Engineering of the Illinois Department of Public Health.

Mr. W. J. Orchard, Director-Consultant, Wallace and Tiernan Co., addressed the banquet session with the history and development of chlorination in the United States. Mr. R. O. Waller, Water Engineer, City of Chicago, presented slides illustrating water disinfection as practiced in Chicago for many years.

Several outstanding papers were presented to the works managers, chemists, state and municipal officials, consultants and students attending the conference.

The following reports were prepared in abstract for use in WATER & SEWAGE WORKS by James E. Laughlin, graduate student in Sanitary Engineering, University of Illinois.

Chemistry of Chlorine

The chemistry of chlorine, its history and its present and future usage was discussed by Edmund J. Laubusch, Technical Manager, The Chlorine Institute, New York. Shipping, storage, handling, cautionary measures, effects and details of the chemical structure and the chemistry of similar constituents were dealt with in the report. He pointed out that sanitary uses of chlorine account for only three percent of domestic consumption in the U. S. although daily production capacity is seven times greater than in 1940.

Disinfectants in Water Treatment

Analytical Procedures for the Control of Disinfectants in Water Treatment was the topic discussed by Robert S. Ingols, Director, School of Applied Biology, Georgia Institute of Technology, Atlanta, Ga. He explained the tests that every water chemist should be familiar with; the standard acid orthotolidine test, the orthotolidine-arsenite test, the "flash" orthotolidine test, the Palin method of serial titration and amperometric titration. He also gave a listing of chemicals to be used to validate tests in actual sewage or waste water. The two forms of ozone found in water (ozone and hydroperoxal ions) were also dealth with.

Germicidal efficiency of compounds

The Germicidal Efficiency of Silver, Iodine and Quarternary Ammonium Compounds was discussed by Cecil W. Chambers, Research Microbiologist, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. He explained the benefits and difficulties of these and other compounds and their possible uses. Due to high cost and danger of burning, ultraviolet light seems to have some disadvantages although it is germicidal to shallow depths. Chlorine dioxide and bromine appear to be effective but cost and draw-backs of these also render them less usable. Quaternary ammonium compounds have not been tested thoroughly enough nor compared to set standards to realize their potentials. Silver and iodine seem to be outstanding disinfectants although they cost considerably more than chlorine.

Feeding, Handling and Storage of Chlorine

Feeding, Handling and Storage of Chlorine was the subject covered by Robert Mann, Midwest Regional Manager, Fischer and Porter Co., Maywood, Ill. He maintains proper equipment, sound understanding and faithful attendance of chlorination facilities, as well as a few added precautions are justified by the importance of the system to good water supply plants. Chlorinators and chlorine containers should be housed by themselves to avoid toxic and corrosion dangers. Floor level ventilating fans and outward opening doors are required. Withdrawal must be done at a limited rate to prevent malfunction.

Disinfection and Oxidation of Domestic Wastes

Disinfection and Oxidation of Domestic Wastes was presented by Raymond E. Anderson, Manager of the North Shore Sanitary District, Waukegan, Ill. The effectiveness of sewage chlorination was pointed out in this striking report of a 13-year beach sampling program conducted on Lake Michigan. Both MPN and BOD dropped in plant effluents after chlorination. MPN was consistantly below the required 2400/ml, while BOD reduction by chlorination was in the 15 to 30 percent range. Water quality at 12 beaches was indexed by MPN tests. These, together with water plant source records, showed dramatic quality improvement after chlorination.

Auxiliary uses of Disinfection Agents

Auxiliary Uses of Disinfection and Oxidizing Agents in Water were discussed by M. E. Flentje, Chief Sanitary Engineer, American Water Works Service Company, Philadelphia, Penn. Oxidation may be used for taste and odor control, iron and manganese removal, destruction of hydrogen sulfide and as an acid to coagulation. Chlorine is very effective in iron removal. Breakpoint chlorination is effective in controlling tastes and odors and lowers activated carbon requirements. Chlorine dioxide deals excellently with phenol compounds. Potassium permanganate is also a powerful oxidant.

E. H. Aldrich Honored

The new E. H. Aldrich plant of South Pittsburgh Water Company is named for the engineer responsible for the design and construction of this ultra-modern water supply and treatment facility.

Mr. Aldrich is Vice President and Engineering Consultant for American Water Works Service Company, Inc., a subsidiary of American Water Works Company, Inc. He is also a Vice President of Northeastern Water Company.

The South Pittsburgh Water Company is a subsidiary of American Water Works Company, Inc., and serves a sprawling 160-square-mile area south and west of the Monongahela River. Considerable growth has occurred during the last decade, and the South Pittsburgh system has shared the growing pains of the 22 boroughs and 8 townships in its service area. Also served are 9 wards of the City of Pittsburgh. Since 1950 the number of customers served

LIQUIDS AND SLURRIES are used exclusively at the new treatment plant. Shown here in foreground is siding where tank cars or trucks may be unloaded. Carbon slurry tanks are immediately below siding. Soda ash slurry is stored in heated tanks at left rear. All other chemical storage tanks are located indoors.

has increased about 50 percent—from 67,000 to just under 100,000. Water sold has risen even faster—from 7,8 billion gallons in 1950 to over 12 billion gallons in 1960—a rise of 56 percent.

More Water Needed

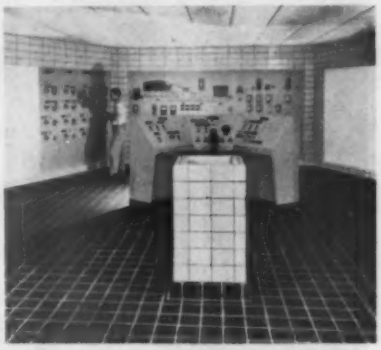
Some years ago the Company was faced with a decision, namely, whether to increase the water treatment capacity of its Hays Mine Station, which has a capability of 50 million gallons per day, or to build an entirely new plant at another location. It was decided to build a new plant at Elrama, Pa., on the Monongahela River. The location is 25 miles from Pittsburgh's famous "Point" and about 21 miles upstream from the Becks Run intake, also on the Monongahela, which feeds the Hays Mine Station.

The Elrama site was selected because it is upstream from most industries in the Pittsburgh area, thus is less affected by pollution and can serve water most efficiently into the southerly end of the distribution system.

That decision resulted in construction of a $6.5 million masterpiece of the science of water treatment and supply—at this writing one of the most highly automated water treatment plants in the nation.

Known as the E. H. Aldrich Station, the new plant has a capacity of 25 mgd, increasing to 75 mgd treatment capacity of the South Pittsburgh system. The Aldrich Station is designed for economic incremental expansion to a capability of 100 mgd as demand warrants.

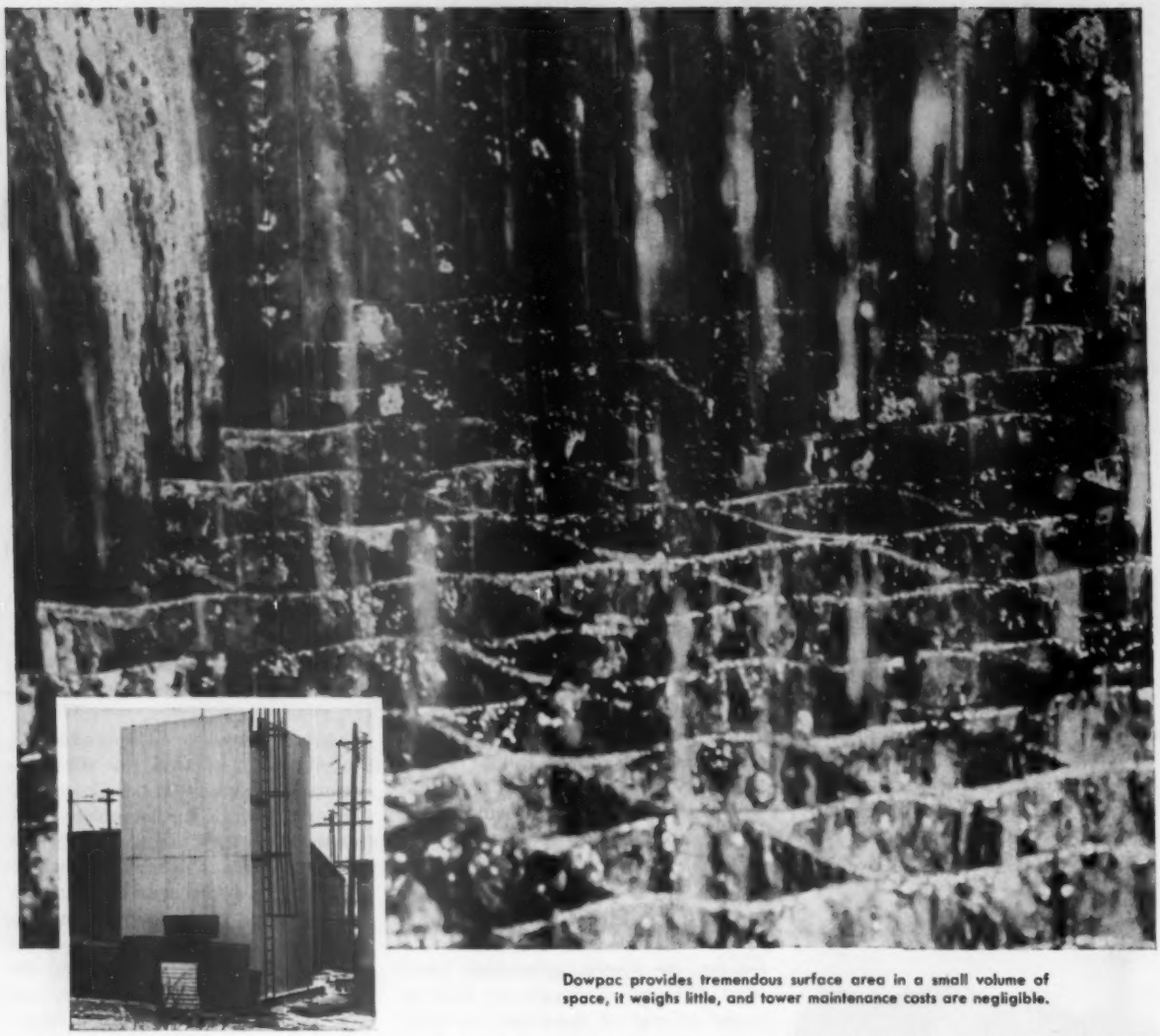
In addition to its automatic features, the Aldrich Station is unique in that all chemicals are stored and fed into the system in solution form. Nine different chemicals are used at times, several of them not normally used in public water supply treatment. The Monongahela River is continuously polluted with acid mine wastes, and proper treatment calls for acid neutralization, coagulation, and, at times, water softening.



OPERATOR CHECKS pneumatic instrument readings in the hexagonal control room. In foreground is clearwell viewing port, behind which is remote low-lift station control console. Graphic plant control panel is wall-mounted in background. All control signals and instruments are pneumatic.

Control features include remote, central control of automatic filter operations, automatically-paced application of chemicals and complete, continuous recording of all operations at a central point. They also include the control of the remote operation of raw water intake pumps and relay pumps, as well as high lift pumps located in the same building, and the customary water level, pressure, and flow recorders at numerous points.

VIEW OF the new E. H. Aldrich station site. Building at left houses pumps, controls, laboratory and chemical feeders. At right are two of the four combination clarifiers and filter units.



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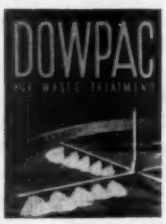
Contoured plastic sheets of Dowpac® packing media interlock (above) to form a continuous, lightweight grid for low-cost treatment of water-borne wastes. Because of light weight and high operating efficiency, a waste treatment system using Dowpac requires much less land area for construction than other waste systems, while operating at higher waste concentrations.

Cost advantages—Economical first cost . . . low maintenance and operating costs . . . conserves expensive land. **Operating advantages**—large area for bacterial growth . . . efficient aeration . . . freedom from plugging. **Total advantages**—a D.I.S. waste treatment system using Dowpac costs you less to install and operate and treats more waste faster, at higher concentrations, than other kinds of systems.

Pilot plants employing Dowpac can be rented or purchased, and D.I.S. engineers will help customers develop the most effective use of Dowpac for their particular waste conditions. Dow Industrial Service works with industries of every kind, anywhere in the U. S. Further, D.I.S. offers consulting laboratory service for water and waste treatment, backed by technical resources of THE DOW CHEMICAL COMPANY. For further information, write or call DOW INDUSTRIAL SERVICE, 20575 Center Ridge Road, Cleveland 16, O., Dept. WSW9.



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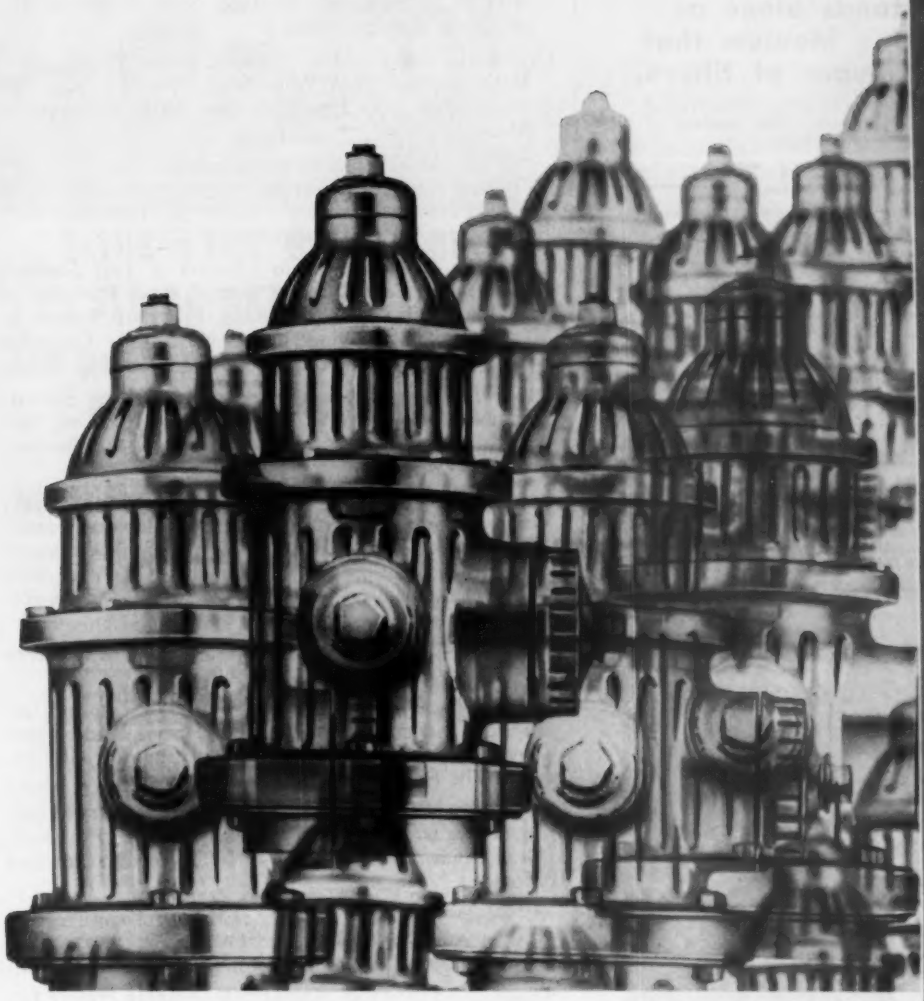

Reasons? Over a million hydrants now in service throughout the world. A number like that speaks for itself, says plenty about the outstanding features of the hydrant and the excellent service and reliability you can expect with R. D. Wood products.

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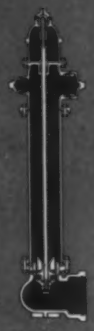
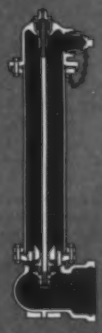


R. D. Wood Mathews Flange Barrel Hydrant . . . dry head construction keeps it operating in every kind of weather.



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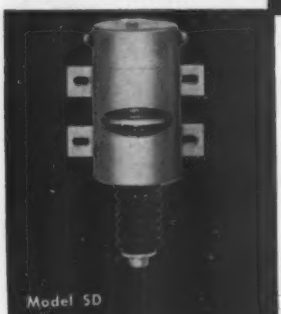
MODEL SL
VOLTAGES .....(D.C. Only) 6V. 12V. 24V. 32V.
CURRENT DRAW....(Pulling) 55A. 35A. 15A. 12A.
CURRENT DRAW...(Holding) 1.6A. .8A. .4A. .3A.
DUTY .....Continuous
CYCLES..... Not to exceed 6 per minute
PULL...Approximately 10 lbs. over ½ inch stroke
WEIGHT.....2½ pounds

Model SL


Model SD

MODEL SD
VOLTAGES .....(D.C. Only) 12V. 24V. 32V. 115V.
CURRENT DRAW....(Pulling) 40A. 20A. 15A. 4A.
CURRENT DRAW...(Holding) .5A. .25A. .20A. .05A.
DUTY .....Continuous
CYCLES..... Not to exceed 6 per minute
PULL...Approximately 10 lbs. over 1½ inch stroke
WEIGHT.....4¼ pounds
Model SM available with 1 inch stroke.

SYNCHRO-START PRODUCTS, INC.
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Meetings

CONTINUED FROM PAGE 8A

Oct. 4-6—Jamestown, North Dakota (*Gladstone Hotel*) North Dakota Section Water & Sewage Works Conf. Secy., W. Van Heuvelen, c/o State Dept. of Health, Bismarck, N. Dakota.

Oct. 5-6—Twin Falls, Idaho. Intermountain Section A.W.W.A. Secy., M. W. Snell, Supt., Power & Water, Soda Springs, Idaho.

Oct. 8-11—Biloxi, Miss. (*Buena Vista Hotel*) Ala.-Miss. Section A.W.W.A. Secy., Ernest Bryan, McWane Cast Iron Pipe Co., Box 2601, Birmingham, Ala.

Oct. 9-12—Milwaukee, Wis. (*Schroeder Hotel*) Thirty Fourth Annual Meeting Water Pollution Control Federation. Secy., Ralph E. Fuhrman 4435 Wisconsin Ave., Washington 6, D. C.

Oct. 9-20—Cincinnati, Ohio (*Robert A Taft Sanitary Engineering Center*) Short Course: Basic Radiological Health. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to a PHS Regional Office.

Oct. 15-18—San Antonio, Texas (*Hilton Hotel*) Southwest Section A.W.W.A. Secy., L. A. Jackson, Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 16-27—Cincinnati, Ohio (*Robert A. Taft Sanitary Engineering Center*) Short Course: Plankton Identification and Control. Write: Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, or to a PHS Regional Office.

Oct. 17-20—Atlantic City, New Jersey. Eastern Water Co. Conference

Oct. 17-Nov. 9—New Brunswick, N. J. (*Rutgers University*) Short Course: Sewage Disposal and Plant Operation. Contact Dean, College of Engineering, Rutgers, The State University, New Brunswick, N. J.

Oct. 18-20—Cedar Rapids, Iowa (*Roosevelt Hotel*) Iowa Section A.W.W.A. Secy., Wilbur E. Bjork, Des Moines Water Works, 1003 Locust St., Des Moines.

Oct. 22-25—Montreal Quebec (*Mount Royal Hotel*) Canadian Institute on Sewage & Sanitation. Secy., Albert E. Berry, 72 Grenville St., Toronto, Ont.

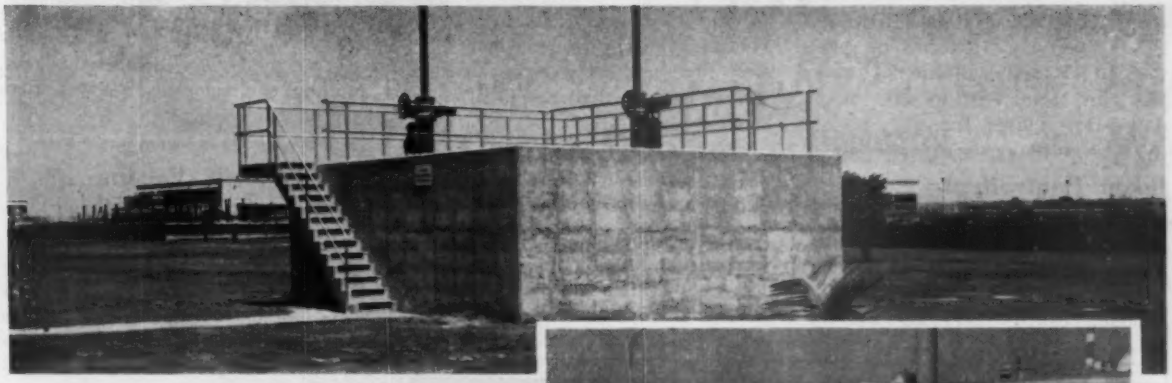
Oct. 23-25—Pittsburgh, Pa. (*Penn-Sheraton Hotel*) International Water Conference of the Engineers Society of Western Pennsylvania. Write: Society Office, Penn-Sheraton Hotel, Pittsburgh 30, Pa.

Oct. 23-27—Monticello, Illinois (*Allerton House*) Tenth Annual Water Works Management Short Course. Sponsored by Illinois and Indiana Sections A.W.W.A. Write: Short Course Supervisor, 116b Illini Hall, Champaign, Ill.

Oct. 23-27—Neosho, Missouri (Water & Sewerage Technical School) Short Course: Sewerage Works Course No. 1. Write: Lloyd Caughran, Director, Water & Sewerage Technical School, Box 348, Neosho, Mo.

Oct. 25-27—Sacramento, Calif. (*Hotel Senator*) Calif. Section A.W.W.A. Secy., Frank F. Watters, Hydr. Engr., State Utilities Com., State Bldg., Civic Center, San Francisco.

at MIAMI'S SEWAGE TREATMENT PLANT...



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LimiTorque automatically opens and closes sluice gates and valves from a conveniently located control point—eliminating guesswork and reducing labor costs. One man can operate any type of gate or valve quickly and dependably in remote, inaccessible or hazardous locations; thus vital operating procedure can be handled easily by key personnel, safely and economically, and at the correct speed . . . And these controls may be mounted on any size gate or valve, in almost any position or location.

LimiTorque controls can be field-mounted on existing equipment—contact your valve manufacturer, or our nearest sales-engineering office.

It is significant that far more LimiTorque Operators are used on Sluice Gates and Valves than any other operator in the World, because they are absolutely dependable at all times . . . you can "always count on LimiTorque."

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Equipment News

CONTINUED FROM PAGE 16A

hydraulic range of 10,000 to 180,000 gallons per day. In terms of settled raw BOD to the Biofilter®, capacities run from 16.0 to 200 lb per day.—Dorr-Oliver Inc.

Circle No. 911 on Reader Service Card

Foam Controllent

Development of a Foam Controllent for use in industrial and municipal sewage treatment plants has been announced by this manufacturer. The product, called "O'B-NO FOAM" is said to be very effective at low concentrations with excellent retention time and very economical per million gallons treated.—O'Brien Industries, Inc.

Circle No. 912 on Reader Service Card

Rust and Scale Remover

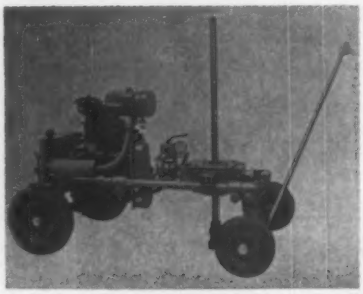
The development of a new industrial rust and scale remover and stainless steel cleaner has been announced by this manufacturer. Known as "Bull Frog" Scale Off No. 104, the product comes in dry powder form and is completely safe and particularly effective in the cleaning of: Compressor jackets, condensers, steam boilers, heat exchangers, and ion exchange resin beds.—Berman Chemical Co.

Circle No. 913 on Reader Service Card

Payne Dean & Company, Clinton, Conn.

Truck-mounted, hydraulic valve operators provide fast, safe control of 10" to 60" valves

One Man Control of Speed and Torque on Gate Stem with Indication. Two Safety Control Devices.



4-Speed Electric Motor Gatenders. For Floor-Stand and Under Floor Operation. 1 to 5 HP 10" To 36" Valves.

Portable Engine Driven Gatenders, For Valves 10" to 36". All Hydraulic Operation. Two Safety Features.

Low Capacity Feeding of Hypochlorite and Other Water Treatment Solutions

The Model 1910-02 Chem-O-Feeder introduced by this manufacturer is an air-operated diaphragm type chemical solution feeder. It is designed to control feeding of hypochlorite and other water treatment chemical solutions into small water systems usually having a capacity of not over 25 gpm.

The Model 1910-02 is only 7⅜ in. long, 5 in. wide and 5¾- in. high. It is wall-mounted for convenient installation and features a transparent "see-through" head of molded, stress-relieved plastic. Operating from air or water pressure (10 to 70 psi), the 1910-02 will deliver from 1.9 to 22.8 gallons per 24 hours. Rates are adjustable by varying of stroke lengths and frequencies.—B-I-F Industries.

Circle No. 914 on Reader Service Card

Improved Water Meter

An improved water meter, Trident Model 60, announced by this manufacturer, offers not only better over-all operating efficiency but important financial advantages.

Featuring complete interchangeability of parts, Model 60 can be repaired, reset and calibrated in the customer's own shop.

Non-fogging sealed register is repairable, can be reset to zero and permits adjustment of registration. It fits older Tridents.

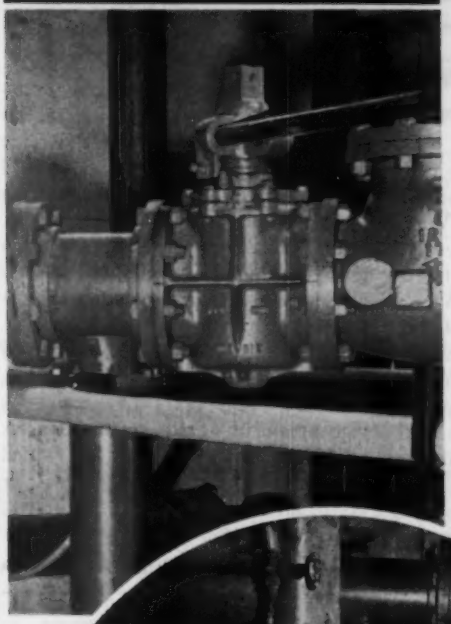
Totally enclosed gear train, sealed and lubricated for life, eliminates corrosion and danger of freezing. It is interchangeable with standard Trident gear trains.

Here is an important financial consideration: Without jeopardizing present investments in meters, all the advantages of the new Model 60 can be built into the existing Trident system by just installing the Model 60 Register and Sealed Gear Train in the older Tridents.—Neptune Meter Co.

Circle No. 915 on Reader Service Card

CONTINUED ON PAGE 92A

DeZURIK Eccentric-Action VALVES

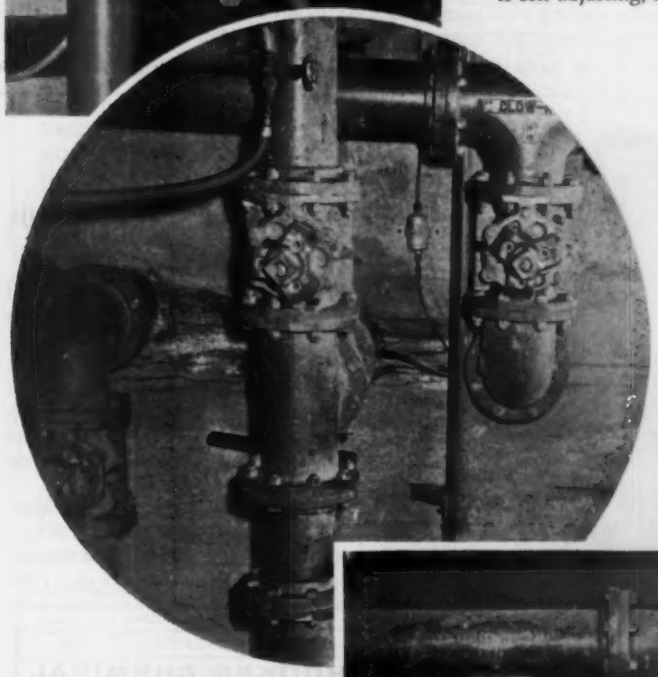


they say "NO!" to valving troubles

LEAK OR DRIP? **NO!**
LUBRICATION? **NO!**
BINDING OR SEIZING? **NO!**
MAINTENANCE PROBLEM? **NO!**
EXPENSIVE? **NO!**

ASK ANY of the hundreds of sewage or water plants using DeZurik Valves . . . they'll tell you that no valves say "NO" more often to valving problems.

ECCENTRIC-ACTION makes DeZurik Valves the most trouble-free ever developed. The eccentric resilient-faced plug delivers a cushioned, complete shut-off, sealing dead-tight every time on any flow. The plug never touches the valve body, can't ever rub or bind. Corrosion-resistant bearing bushings prevent freeze-up no matter how often or how seldom the valve is used. The easiest quarter-turn opens or closes a DeZurik Valve, with accurate throttling through the cycle. Leak-proof stem-seal is self-adjusting, rarely if ever needs repacking.



LOW IN COST, HIGH IN ECONOMY!

Size for size, DeZurik Valves are reasonably priced. They save many dollars through longer life without maintenance, and they repay their cost many times in their positive prevention of leaks and downtime.

DeZURIK ECCENTRIC-ACTION VALVES ARE AVAILABLE in sizes from ½" thru 30", for manual or automated service. Also available: DeZurik 3-way and 4-way Vee-Port Valve and DeZurik Knife-Gate Valves. WRITE FOR BULLETINS.

DeZURIK CORPORATION
SARTELL, MINNESOTA

Photos directly above and right: Some of the many DeZurik Valves in the new sewage treatment plant at New Albany, Ind., Consoer & Townsend, Consultants; Fruin-Colnon Contracting Co. and C&C Construction Co., Inc. Contractors.

News of Suppliers

Fischer & Porter Sponsors Tour of Orange Co. Sewage Plant for ISA Visitors

Fischer & Porter Company will sponsor a tour of the Orange County sewage treatment plant, Huntington Beach, California, as part of the F&P program at the 1961 ISA Conference and Exhibit in Los Angeles.

The tour is designed to give interested ISA visitors a working demonstration of what has been called the largest completely automatic chlorination station in the world. F&P instrumentation at the station includes chlorinators and evaporators, residual chlorine analyzer, ORP recording and control equipment, sludge meters, and magnetic flowmeters up to 36 in. in diameter. These measure sewage flows as high as 50 million gallons per day.

The tour will leave for the sewage plant from the lobby of the Statler Hilton Hotel, Los Angeles, at 9 AM on 12 September, and will return to the hotel at approximately 1 PM that afternoon. Round trip transportation will be provided by Fischer & Porter Company.

Nichols Engineering & Research Corp. Announces Appointment of Sales Director

Charles W. Nichols, Jr., president of Nichols Engineering & Research Corp., New York, has announced the appointment of H. Bach Nielson as Assistant to the General Manager of the firm. In his new capacity Mr. Nielson will have over-all supervision of Nichols' sales, which includes the supplying of equipment and engineering services to the pulp and paper, chemical processing, food and flavoring, ceramics, mining,pharmaceutical and sanitary engineering fields.

Mr. Nielson was formerly Manager of Nichols' Nerco-Niro Spray Dryer Division. He is a graduate engineer of many years experience, both in this country and abroad.

C. B. & I. Co. Announces Four New Vice Presidents

Election of two senior vice presidents and two vice presidents has been announced by Chicago Bridge & Iron Company, world wide, steel plate fabricating and construction firm headquartered in Chicago.

H. J. Clarke and S. C. Hamilton are the senior executives. Newly elected vice presidents are J. T. Horton and M. G. Mitchell.

Mr. Clarke is now in charge of the Company's operating department, following nine years of service as vice president—field construction. A CB&I director since 1954, he joined the company in 1927, shortly after his graduation as a Civil Engineer.

Mr. Hamilton assumes the posi-

CONTINUED ON PAGE 90A

YOU CAN'T BE TOO CAREFUL WITH CHEMICALS

Because most workmen are careful and respectful of potentially hazardous chemicals, accidents don't often happen.

You don't have to handle chlorine cylinders quite this way, but don't let *your* men become complacent. Keep those safety posters out where they are a constant reminder of the correct ways to do things.

If you'd like an additional supply of posters showing the best ways to handle chlorine, let us know. We'd also like to send you a copy of our 76-page chlorine manual. Ask for it.

HOOKER CHEMICAL CORPORATION

1709 UNION STREET
NIAGARA FALLS, N.Y.

HOOKER
CHEMICALS
PLASTICS

Sales Offices: Buffalo, Chicago, Detroit, Los Angeles, New York, Niagara Falls, Philadelphia, Tacoma, Worcester, Mass.

In Canada: Hooker Chemicals Limited. North Vancouver, B. C.

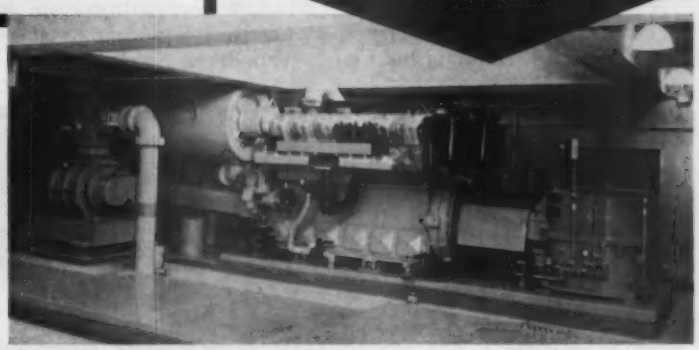
WAUKESHA POWER for MUNICIPAL PLANTS

NATURAL OR SEWAGE GAS • GASOLINE • DIESEL • LP GAS

10-1235 HP

ENGINES

Waukesha engines for water and sewage applications are available for gas or gasoline fuels or as normal or turbocharged Diesels. From this complete line select exactly the *right* engine. Materials, design, and operating characteristics are the result of over fifty years' experience in building fine engines. For honest, reliable, profitable operation, you cannot buy better engine power.



Model VLRO—Central Contra Costa Sanitary District, near San Francisco.

NATURAL GAS SEWAGE GAS LP GAS GASOLINE					DIESEL FUEL ENGINES				
Model	B & S	Cyl.	Displ.	Max. HP@ RPM	Model	B & S	Cyl.	Displ.	Max. HP@ RPM
135-GZ	4⅛x5	6	451	135@ 2400	148-DK	5¼x6	6	779	200@ 2100
140-GZ	4⅛x5½	6	554	191@ 2400	148-DKBS	5¼x6	6	779	280@ 2100
145-GZ	5⅛x6	6	817	240@ 2400	WAKD	6¼x6½	6	1197	258@ 1800
WAKC	6¼x6½	6	1197	309@ 1800	WAKDS	6¼x6½	6	1197	400@ 1800
NKR	7 x8¼	6	1905	343@ 1200	NKD	7 x8¼	6	1905	297@ 1200
LROR	8½x8½	6	2894	515@ 1200	NKDS	7 x8¼	6	1905	390@ 1200
LRZ	9⅛x8½	6	3520	590@ 1200	LRDC	8½x8½	6	2894	415@ 1200
VLRO	8½x8½	12	5788	980@ 1200	LRDCS	8½x8½	6	2894	695@ 1200
					VLRD	8½x8½	12	5788	905@ 1200
					VLRDS	8½x8½	12	5788	1235@ 1200

Ratings shown are maximum. Continuous ratings and speeds are in Waukesha Chart 1079. *Models here* are most frequently used for municipal service. Waukesha's approximately 30 gas, gasoline and Diesel models range from 10 to over 1200 hp. Turbocharged Diesels indicated by letter "S" in table.

ENGINATORS®

Waukesha Enginators are accurately balanced engine and generator combinations that perform dependably in all applications requiring a smooth, steady flow of power for continuous, intermittent and stand-by duty. 50 to 800 KW capacities—gas, gasoline, normal or turbocharged Diesel operation.

350 KW (Model LRDCSU) Waukesha Diesel Enginator.

Approximate ratings—consult Waukesha Motor Co. for ratings applicable to your service.

MUNICIPAL ENGINATORS—CONTINUOUS DUTY RATINGS (Kilowatts)									
DIESEL ENGINATOR SERIES					GAS ENGINATOR SERIES				
MODEL	60-Cycle RPM				MODEL	60-Cycle RPM			
	720	900	1200	1800		720	900	1200	1800
135-DK	NA	NA	NA 50*	60 75*	135-GZ	NA	NA	35	50
148-DK	NA	50 NA*	65 85*	100 150*	140-GZ	NA	NA	45	65
WAKD	NA	75 120*	100 150*	125 200*†	145-GZ	NA	NA	70	100
NKD	100 125*	125 150*	150 200*†	NA	WAKC	NA	85	110	150†
LRD	150 200*	185 275*	250 350*†	NA	NKR	106	130	160†	NA
VLRD	325 400*	400 500*	500 675*†	NA	LROR	160	200	250†	NA
					LRZ	200	250	300†	NA
					VLRO	325	400	500†	NA

NA = NOT AVAILABLE. Ratings based on standard conditions—29.92" Hg. Barometer and 60° F. Air Temperature. Ratings are maximum KW for continuous duty at sea level at speeds indicated. Gas models rated using 1000 BTU Natural Gas. For Diesel models, upper KW ratings are for naturally aspirated models, and lower ratings marked * are for turbocharged models. Ratings are for radiator cooled fan units. Higher ratings permissible with heat exchanger cooling. Higher ratings available for intermittent and stand-by service. † Consult Waukesha Motor Company stating specific applications details.

WAUKESHA MOTOR COMPANY

WAUKESHA, WISCONSIN

NEW YORK • TULSA • HUNTINGTON PARK, CALIF.

Factories: Waukesha, Wisconsin; Clinton, Iowa; Houston, Texas 516-R

News of Suppliers

CONTINUED FROM PAGE 88A

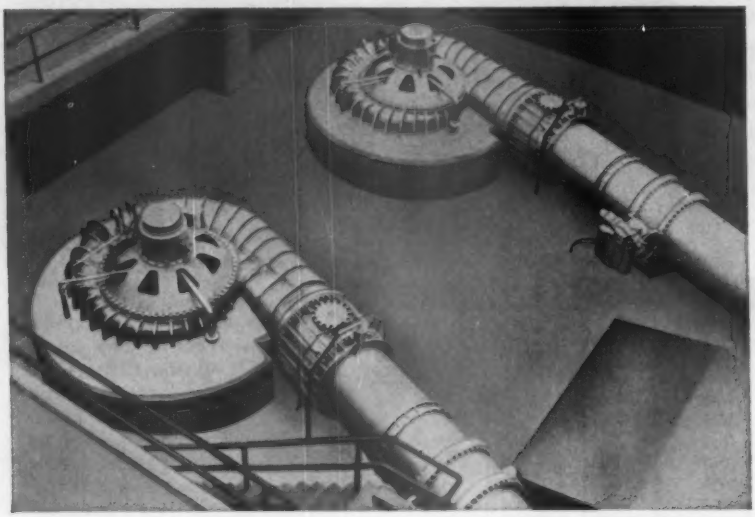
tion of senior vice president of the contracting department. He has been a CB&I director since 1946 and was vice president-sales for some four years.

New Sales Planner for Henry Pratt Co.

The Henry Pratt Company has appointed Abdon J. Brazaitis and Clarence L. Carlson to the post of Sales Planner.

Mr. Brazaitis will be responsible for Rubber and Metal Seated Butterfly Valves and Expansion Joints. Mr. Carlson will be responsible for Rubber Seated Ball Valves and Automatic Strainers.

Both men will operate from the Company Headquarters at 319 West Van Buren Street, Chicago, Illinois.



YOU'RE looking at two C. H. Wheeler 67,000 gpm Vertical, Bottom Suction, Side Discharge, Mixed Flow Dual Volute Pumps. They are operating at the Helena Valley Pumping Plant of the Bureau of Reclamation's Missouri River Project. These pumps provide sufficient irrigation water to permit the farming of 17,500 previously unproductive acres of Montana farmland.

The C. H. Wheeler Dual Volute design is especially valuable when a pump is required to operate over a wide range of operating conditions.

Both pumps have side discharge. An unusual C. H. Wheeler designed bottom suction permits taking water from the same penstock that drives the Water Turbines.

High-head, high-capacity pumps such as these have unlimited application in municipal water supply and irrigation services . . . another instance of applying C. H. Wheeler design to special pumping problems, with assurance of proper performance.

C. H. WHEELER MFG. CO.

PHILADELPHIA 32, PA.

Affiliates: GRISCOM-RUSSELL • KLIPFEL VALVES

Centrifugal, Axial and Mixed Flow Pumps • Sea Water Distilling Plants • Finned Tubing • Heat Exchangers • Steam Condensers • Ejectors • Marine Steering Gears & Auxiliary Equipment

C. M. Comstock Promoted by Dorr-Oliver

Charles M. Comstock, advertising manager of Dorr-Oliver Incoporated, has been named manager of the newly formed CompleTreator Sales Division of that company, according to a release. George F. Lambeth, sales specialist, replaced Comstock, with the new title of advertising and publicity manager.

In his new position, Comstock will be responsible for developing a network of distributors to market and service D-O CompleTreator sewage treatment systems and DorrClone water desanding systems.

New Vice President of Badger Meter Manufacturing Co.

Ross J. Burns, formerly general sales manager of the water meter division, Badger Meter Manufacturing Company, Milwaukee, has been elected Vice President in charge of municipal sales at a meeting of the board of directors of the company. The announcement was made by President J. O. Wright.

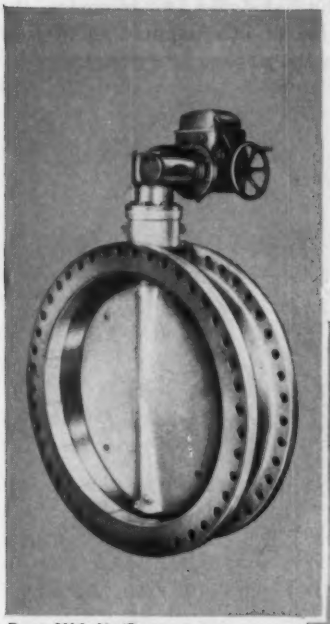
Mr. Burns has been associated with the water meter industry for 30 years.

Neptune Opens New Office, Warehouse in Chicago

A new district sales office and warehouse to serve customers in Illinois, Michigan, Minnesota, the Dakotas, Wisconsin and Northern Indiana has recently been completed by Neptune Meter Company's Liquid Meter Division. Located at 65 Scott Street, Elk Grove Village, Ill., in the Chicago metropolitan area, the new one story building contains 12,000 sq. ft. of space.

The warehouse area in the new building will stock types of Neptune meters which are popular in the midwest. In addition, the building will contain complete equipment for testing and reconditioning all sizes and types of Neptune water, industrial and petroleum meters.

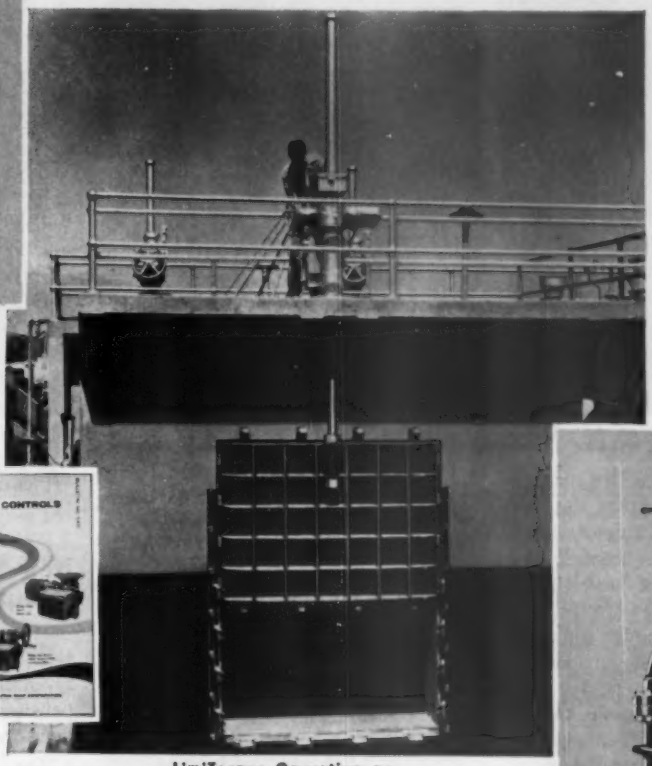
THERE IS NO SUBSTITUTE FOR LimiTorque



Type SMA LimiTorque operating a Henry Pratt Company 48" Butterfly Valve.

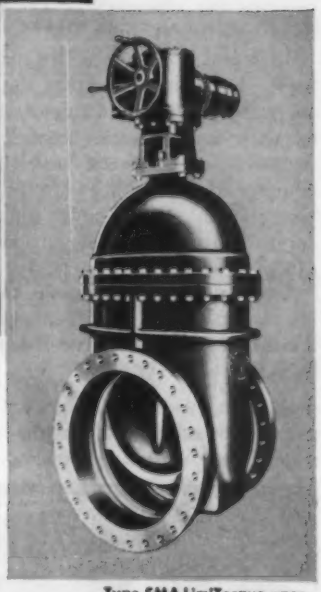
Yes! there is no substitute for LimiTorque. More engineers are recognizing this daily. A recent specification, from which we quote, "The motor operated valve shall be of the Philadelphia 'LimiTorque' type or full equal. Because this type has been proven in service similar to that for which this valve will be used and because of unsatisfactory results with other operators" . . . recognized the superiority of LimiTorque Valve Controls.

Why don't you specify LimiTorque?



LimiTorque Operating an 84"x60" Armco Sluice Gate.

For the full story on LimiTorque's Time and money-saving features, write for Bulletin #1-60.



Type SMA LimiTorque operating a 30" A. P. Smith Co. Gate Valve.

LimiTorque has acceptance around the world being used widely in most every industry such as, Power, Chemical, Petroleum, Petro-Chemical, Pipelines, Water, Sewage, Marine, Aircraft and Missile. LimiTorque can be depended upon to operate your valves under the most adverse climatic or operational difficulties.

LimiTorque Controls can be field mounted on existing valves—contact your valve manufacturer, or our nearest sales engineering office.

THERE IS NO SUBSTITUTE FOR

LimiTorque®

PHILADELPHIA GEAR CORPORATION

KING OF PRUSSIA (SUBURBAN PHILADELPHIA), PA.

Offices in all Principal Cities

PRECISION GEARS • INDUSTRIAL GEARS • SPEED REDUCERS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • King of Prussia, Penna.

Equipment News

CONTINUED FROM PAGE 86A

Auxiliary Governor System

An auxiliary governor system to control the speed of power equipment with a wide variation in load requirements has been introduced by this manufacturer.

The new system is the first practical control to automatically adjust power supply to keep power take-off speed constant. The new governor will provide positive protection for costly hydraulic pumps and will help lower maintenance costs and increase the efficiency of the equipment on which it is installed.

Principal applications are made by utility body manufacturers for special purpose trucks and tractors equipped with earth augers, diggers, compressors, winches and other heavy equipment for utility companies, construction firms and municipal service maintenance departments.—Holley Carburetor Co.

Circle No. 916 on Reader Service Card

Treatment of Water-Borne Wastes

A new plastic packing for efficient and economical treatment of water-borne wastes in trickling filter

applications is now being produced and marketed by Industrial Service, Cleveland, a division of the Dow Chemical Company.

Called Dowpac® 20A, the new material consists basically of individual sheets, corrugated in two directions, measuring approximately 36 in x 21 in. A unique self-spacing design permits the sheets to be assembled side by side to form a cubic module for erecting an aerating tower of appropriate size.

The special configuration of the sheets is designed (1) to distribute falling liquid wastes in thin films over large surface areas so that maximum aeration efficiency is obtained; (2) to provide a high percentage of void space for unimpeded natural-draft ventilation and waste flow; and (3) to provide large surface areas to which active biological slimes can adhere.—Dow Industrial Service Div., Dow Chemical Co.

Circle No. 917 on Reader Service Card

Compact Everguard Monitors Liquid Levels

An entirely restyled electric "watchdog" that sounds a clearly audible alarm, automatically shuts off pumping equipment, opens or shuts solenoid valves, or cuts in auxiliary supplies whenever a specific liquid low or high level is reached is offered by this manufacturer.

Besides being an important accessory to warn automatic chlorination-equipment operators that their chlorine solution level is low, the new instrument has unlimited application whenever low or high liquid levels need to be controlled.—Everpure, Inc.

Circle No. 918 on Reader Service Card

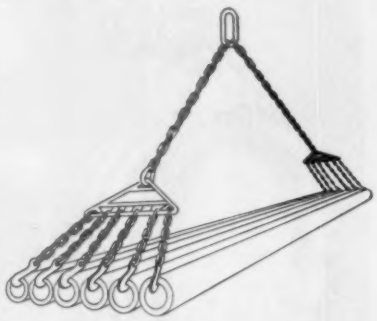
Slip Proof Fabric

"Slip Proof Fabric", a new pressure sensitive safety tread product, has been recently introduced by the manufacturer. "Slip Proof Fabric" comes in handy cleats or strips for stairways, ladders, fire escapes. It is also available in rolls up to 24 in. wide x 96 in. long for tailoring to practically any safety tread problem in homes and factories.—The Carborundum Co.

Circle No. 919 on Reader Service Card

Special Pipe Lifting Assembly

A special pipe lifting chain assembly, designed to minimize the number of lifts required to lift and transport structural beams, pipe or tubing has been announced by this manufacturer.



This assembly consists of an Accoloy 125 double leg sling chain with master link and pear-shaped end links to which are attached two specially engineered triangular members from which are suspended several dropper chains which can be equipped with sling hooks, sorting hooks or any other type of hook for particular needs.—American Chain Div., American Chain & Cable Co. Inc.

Circle No. 920 on Reader Service Card

New "Bearing In Case" Pump Design

A unique and exclusive pump design, which permits flexible coupling to standard motors instead of expensive high-thrust motors, has been developed by this manufacturer.

The new design is based on the use of carbides in the manufacture of sleeve bearings and journals. In the new design, a carbide bearing and journal are placed within the pump case, between the impeller and packing box, thus drastically reducing impeller overhang. A self-aligning spherical roller thrust bearing, or plate type thrust bearing, is employed to carry impeller thrust and weight of rotating parts. This arrangement reduces the overall height of the pump, minimizes shaft misalignment and vibration, and allows the use of standard motors instead of the more costly high-thrust motors.—C. H. Wheeler Mfg. Co.

Circle No. 921 on Reader Service Card

CONTINUED ON PAGE 94A

Mirrors, rectangles, and other tremendous trifles make Shone® your bargain buy in sewage ejectors

When 91 years of engineering and experience go into a **sewage pumping device**, there can be only one result—an ejector that is so much in a class by itself, it becomes an "institution" . . . a piece of equipment that keeps other ways of handling sewage **perennially obsolete** . . . a mechanism that makes embarrassing service interruptions and dangerous climbing in-and-out of manholes things of the past. Each part, each material, each contour, each surface of the Shone ejector has significance in the vital job of handling sewage.

1. Consider the **mirror-like** "superfinish" (you can **actually shave** in it) surfaces of the pilot valve slides and seat of the Shone's exclusive control system. Hand-lapped to perfection . . . only the weight of the valve slide plus pilot air pressure maintain the seal for decades of operation. Faces of the two parts fit so accurately that it is actually difficult to pull them apart. There is no leakage . . . opening and closing are truly positive. Parts do not wear "out of balance," because they are "broken in" before leaving the factory.

2. Piston valve and **pistons** are also "superfinished" to the same mirror-like surface . . . and a test of **each** valve **assembly** assures operation at only 60% **of the minimum** allowable pilot and **operating** pressure.

3. Or consider the singularity of **rectangular valves** in round pipes. Sticks and stones in sewage may "bridge" in a round pipe under low-flow conditions. Not only are the Shone's valves rectangular, but they have a larger internal cross section than the pipes to which they are connected. This is one of several reasons why **nothing** (but nothing) can choke a Shone ejector in this "bottleneck" spot. Anything which reaches the receiver passes through it and through the discharge valve.

4. We all know cotter pins are fine on tricycles (and on **external** linkage), but not inside pneumatic ejector inlet and discharge valves. You can't find a more perfect **snagger** for rags and other strangulating debris. Shone has flush-driven pins on valve hinges, another tremendous trifle.

5. A newly-cast, iron receiver, like any good whiskey, needs to be aged. Receivers for Shone pneumatic ejectors are "mellowed" for up to one year. This settles them down, prevents cracks and warping by relieving internal stresses in the crystal structure. Remember that Shone sewage ejector installations are usually considered permanent — the **first U. S. installation, 1889, is still in service.** An important invisible extra!

6. There are no "missing links" in the control linkage assembly of a Shone ejector. **Each** assembly is set, tested, dowled, and "match-marked" for its **own** particular receiver assembly. No trial and error fitting on the job. Another Shone "intangible" asset.

7. Tipsy control rods are obviously going to be less than 100% efficient. Shone bell rods are sober, straight, and only work with or against the forces of the bells and gravity. There is **no** side thrust to deform the packing seal. A trifle? No, a reason why Shone packing boxes go **years** without repacking.

8. Today, nothing is truer than "time is money." A special cast iron header, job tailored for each unit, holds field fitting, pipe cutting, etc., to bare necessities. Duplex units are complete with cross connections. The installer spends his time installing!

*Would you like to hear more about how these and other design subtleties which make Shone the startling bargain in **sewage** pumping equipment? Call your Yeomans representative. He's in the Yellow Pages.*

E-6142

YEOMANS 1999-9 North Ruby Street Melrose Park, Illinois

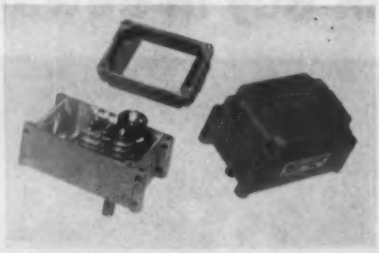
WASTE HANDLING SPECIALISTS FOR OVER 60 YEARS

Equipment News

CONTINUED FROM PAGE 92A

Rotary Limit Switch With Gear Coupled Potentiometer

This manufacturer has developed a complete line of low ratio, geared-down and geared-up rotary limit switches with gear coupled potentiometer options. The photograph illustrates a four circuit unit with a 1:1 ratio for the cams and a 1:3 ratio for the potentiometer.



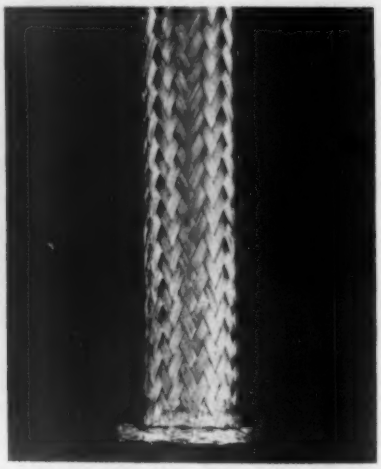
A typical application would be controlling end limits of a motor operated valve with the potentiometer providing continuous valve position indication in a remote location. Other uses include conveyors, ovens, hoists, mechanical presses, handling fixtures and so forth.—Gemco Electric Co.

Circle No. 922 on Reader Service Card

New Concept In Pressure Tube Filter

A revolutionary concept in liquid clarification is claimed for the new Flex-Tube Filter. The heart of the Flex-Tube Filter is the braided wire or plastic tube, the design, movement, and action of which was inspired by the old "Chinese Finger Trap". When pressure is applied to the Flex-Tube, it elongates and shrinks in diameter as did the Chinese Finger Trap.

When pressure is removed from the Flex-Tube, it returns to its original diameter and length with each individual strand moving independently to quickly clear the surface of cake. To insure complete removal of all particles, the free-floating nest of Flex-Tubes can be easily bounced, shaken and rocked automatically or manually.



To handle all types of liquid clarification or "polishing", the strands of the Flex-Tube can be stainless steel, monel metal, or any of the new plastics that can be produced in a monofilament.—Filtomor Inc.

Circle No. 923 on Reader Service Card

Tubular Element Pressure Filters

Tubular element pressure filters for filtering of cooling water to remove silt, condensate to remove oil and suspended corrosion products,

TRIANGLE BRAND COPPER SULFATE

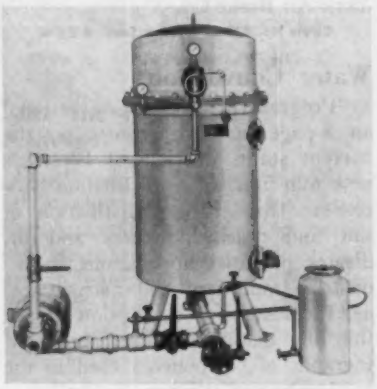
Small, economical dosages of Triangle Brand Copper Sulfate will make your water supply palatable. It destroys algae and aquatic weeds that cause bad water odors and give water an unsavory taste. ■ Another important use of Triangle Brand Copper Sulfate is for the control of root growths, fungi and slime in sanitary sewers and storm drains without damaging trees and shrubs. ■ Write today for complete information on the use of Triangle Brand Copper Sulfate in water supply systems, sewers and drains.

NICHOLS TRIANGLE BRAND CHEMICALS

phelps dodge refining corporation

300 PARK AVENUE • NEW YORK 22, NEW YORK

process water to remove trace contaminants and for clarification of drinking water have been introduced by this manufacturer.



The filters are the polishing type which can effectively remove suspended particles as small as one micron in size. Tubular elements (septums) are available in either plastic or stainless steel. Available in 11 standard sizes, the filters can be mounted singly or in a multiple instaliation for high flow rates.—Water Chemical Sales Div., Hagen Chemicals & Controls, Inc.

Circle No. 924 on Reader Service Card

Teflon-Sleeved Plug Valves

New 8 in., 10 in. and 12 in. Teflon-sleeved plug valves—the first of this type valve available in these large sizes—have been introduced by this manufacturer.

Main features are: specially-tempered Teflon sleeves with sculptured body bore to insure bubble-tight sealing even on temperature fluctuating service; absence of sediment catching flow pockets; quick, easy operation (manual or automatic); and wiping action of the sleeve on the plug as it rotates to keep it clean and free of adhering solids of liquid films.—Continental Mfg. Co.

Circle No. 925 on Reader Service Card

4-Pen Electronic Recorder

A new 4-pen Electronic dynamaster® Recorder has been announced by this manufacturer.

Ideally suited where space is a problem, or where four simultaneously recorded variables must be compared on a time basis, the new instrument is actually four instruments in one case. It will record any set of variables that can be transduced into an electrical quantity. Each pen has its own motor driven balancing unit. There is, therefore, ample torque available for auxiliary functions such as retransmitting slide wires and alarm contacts.—The Bristol Co.

Circle No. 926 on Reader Service Card

MH Roll-call for water

the DEMON FIRE

Some of the largest and most modern water works systems in the U.S. are located here in the east-north-central States. It is hard to believe that here 90 years ago, a sprawling, shambling frontier city built of wood, practically burned to the ground when Mrs. O'Leary's cow kicked over a lantern. The Chicago Fire in 1871 was one of the first great disasters of U.S. history. It destroyed $200 million in property and took 250 lives.

U.S. Department of Commerce lists 85 midwest cities today as having adequate and efficient water works, with an overload capacity 20% in excess of maximum-day load. But the Department also lists 16 midwest water works as inadequate and 18 additional water systems as definitely deficient! Here lives some 15 million Americans — But over 3 million of them have inadequate water supply facilities!

Annual property loss from fire in the U.S. in 1959 was in excess of 1 billion dollars. At the same time, approximately half of the water works facilities of the U.S. are inadequate or deficient in capacity. Considering present water distribution deficiencies and increasing demand due to population growth, it is estimated that water supply facilities will need to be doubled within the next 20 years.

Ohio
Indiana
Illinois
Michigan
Wisconsin

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

New Literature

AVAILABLE FREE

Close-Coupled End-Suction Pumps

Eight-page Bulletin 108 illustrates and describes the new Type GBM Close-Coupled End-Suction Centrifugal Pumps, recently announced by this manufacturer. Also included are cross-sectioned views, selection chart, dimensions, optional assembly positions, parts identification, limitations chart, and specifications.

Especially designed for high efficiency and low horsepower requirements, these pumps are suitable for a wide variety of OEM applications, cooling towers, air conditioning systems, boiler feed, condenser circulation, and general liquid services handling hot or cold liquids. Capacities range to 1600 gpm, heads to 330 ft., and temperatures to 250°F. —Aurora Pump Div., The New York Air Brake Co.

Circle No. 927 on Reader Service Card

Water Conversion

"Progress in Water Conversion," an 8-page bulletin, reports on the current status of General Electric's new thin-film water distillation process for the efficient distillation of salt and brackish waters and indicates potential applications in industrial, municipal and marine areas. Included is a description of the thin-film distillation unit, plus photographs of components used in the apparatus and the experimental setup in which feasibility of the technique has been demonstrated.—General Electric Co.

Circle No. 928 on Reader Service Card

Bulletin on Acid-Proof Cements

"Resistance Charts for Acid-Proof Cements," a new bulletin to be used as a guide in selecting the proper acid-proof cement for corrosion proof installations, is now available.

This bulletin contains a list of more than 75 corrodent solutions and a rating for the various types of acids-proof cements at temperatures of 75°F and 140°F.—Acid-Proof Cement Manufacturer Association

Circle No. 929 on Reader Service Card

Solids Flow Meter

Specification sheet (M22-6) illustrating and describing the operation of a new Solids Flow Meter is now available. It discusses the application of the solids flow meter for the measurement of granular materials such as coal, ore, and crushed rock in vertical ducts, spouts, or pipes.

Operating characteristics including accuracy, sensitivity, and principles of operation are listed along with installation requirements, accessories and physical characteristics.—Bailey Meter Co.

Circle No. 930 on Reader Service Card

Surge Arrestor Valve

New 16-page Bulletin W-16 describes this manufacturer's Cushioned Surge Arrestor Valve that anticipates the surge to protect the system. Pilot controls automatical-

Tough break, but a cinch to sanitize—

with dry, convenient HTH chlorination. HTH releases effective, dependable chlorine to treat any emergency situation quickly . . . kill bacteria, algae and fungi fast. HTH sanitizes new pipe lines, protects wells and reservoirs, too. Comes in either free-flowing granular form or handy tablets . . . packed in easy-to-handle new 3-¾ lb. plastic containers, the popular 100-lb. drums, and in 35-lb. pails. Write for details today: **Olin Mathieson, Baltimore 3, Maryland.**

Here's to Health . . . **HTH**

HTH® is a trademark

CHEMICALS DIVISION Olin

5312

ly open main valve on abnormal pressures, subnormal pressure, or electrical power failure. Complete technical details and drawings are included.—Golden-Anderson Valve Specialty Co.

Circle No. 931 on Reader Service Card

Units for Removing Hardened Waste

Bulletin H-60 describes Hy-Blast high-pressure water/air/sand and water/air units for removing hardened waste and sludge without injury to equipment. Also Hy-Blast JET self-propelling nozzles for easy cleaning of piping and tubing.—Friend Manufacturing Corp.

Circle No. 932 on Reader Service Card

Concrete and Mortar Considerations

A comprehensive check list including such vital topics as job requirements and conditions, concrete floors, concrete in plastic and hardened state, curing and surface-after treatments considered when specifying concrete and mortar is contained in the Master Builders publication, X-6, "Considerations for Concrete and Mortar."

Also covered is masonry mortar, grouting mortar and mortar for miscellaneous use.—The Master Builders Co.

Circle No. 933 on Reader Service Card

Honeywell Scientific & Test Instruments

48-page catalog (2nd. revision) illustrates and describes Honeywell instruments and systems widely used in the field of scientific measurement, recording, and testing.

The catalog describes Amplifiers, Components, Data Handling Systems, Lab and Calibration Instruments, Magnetic Tape Instrumentation, Nuclear Instrumentation, Oscillographs, Electronic Medical Systems, Recorders & Indicators, Relay Racks, Temperature Controllers, Temperature Sensing Elements, and Process Transmitters.—Minneapolis-Honeywell Regulator Co.

Circle No. 934 on Reader Service Card

Gate Valves for Sewage and Waste Treatment Plants

Circular 24, a four-page brochure, illustrates and describes this manufacturer's line of Solid Wedge Gate Valves for sewage and waste treatment plants.

The bulletin discusses the advantages of solid wedge valves, over other types, in handling grit and solids in sewage and waste treatment plants. Main advantages listed are: 100% use of pipe area means full flow capacity, reduced friction loss and lower power costs; operates equally well in any position; longer life; does not require lubrication; less maintenance; can be used for throttling services; cylinder or motor operated where required, remote or manual control.—M & H Valve and Fittings Co.

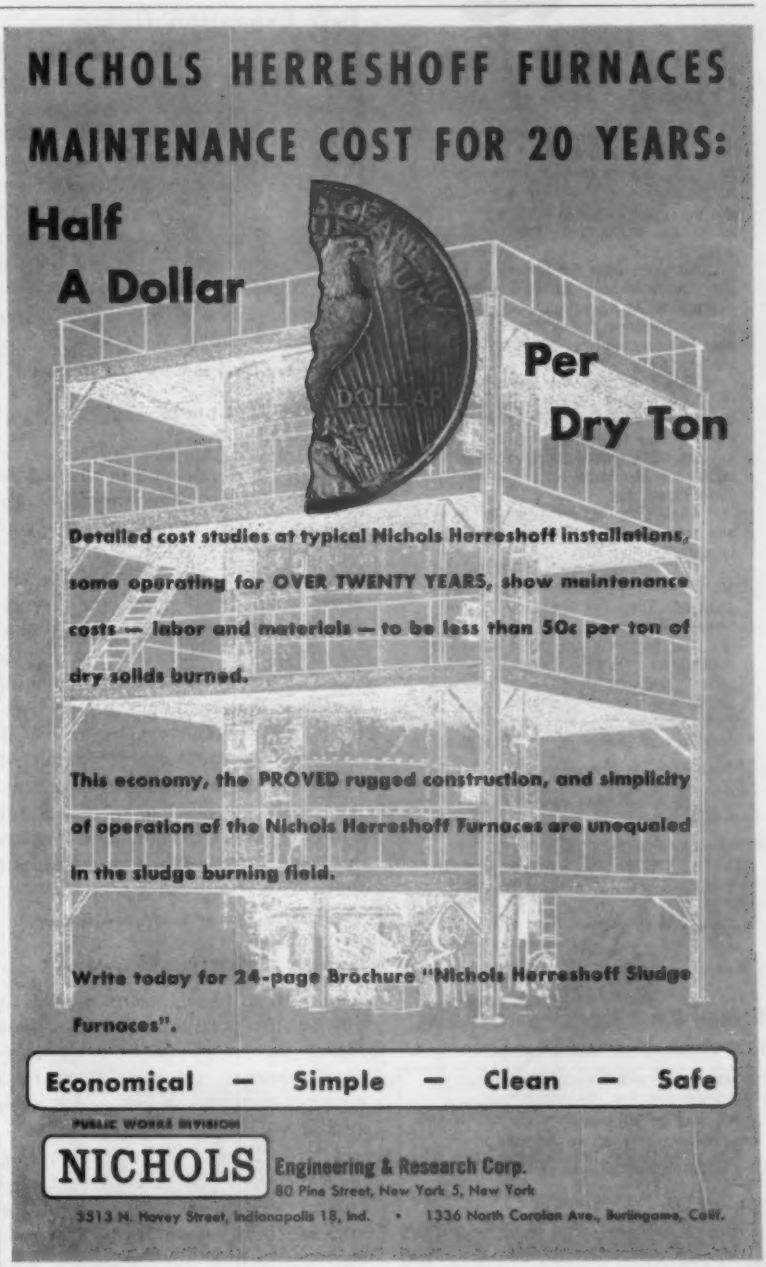
Circle No. 935 on Reader Service Card

Welded Steel Grating

8-page brochure illustrates and describes this manufacturer's Gary Welded Steel Grating featuring the use of hexagonal cross bars for maximum strength. The cross bars and bearing bars are pressure welded into strictly one-piece grating with the tops of all bars being flush.

The grating can be precut to cus-

CONTINUED ON PAGE 98A


NICHOLS HERRESHOFF FURNACES
MAINTENANCE COST FOR 20 YEARS:
Half
A Dollar
Per
Dry Ton
Detailed cost studies at typical Nichols Herreshoff installations, some operating for OVER TWENTY YEARS, show maintenance costs — labor and materials — to be less than 50¢ per ton of dry solids burned.
This economy, the PROVED rugged construction, and simplicity of operation of the Nichols Herreshoff Furnaces are unequaled in the sludge burning field.
Write today for 24-page Brochure "Nichols Herreshoff Sludge Furnaces".
Economical — Simple — Clean — Safe
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NICHOLS Engineering & Research Corp.
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who framed this Engineer?

He was Sanitary Engineer working on the construction of an Air Force base in Texas*. He's a good engineer—asked for the right kind of sanitary sewer pipe. But the regulations read "lowest bidder," so he got a substitute that he didn't want.

Six years later the substitute pipeline had to be dug up, at tremendous expense to the taxpayer. Everybody forgot by that time that the framed engineer had screamed for the right pipe in the first place.

Before the war, only Lifetime Vitrified Clay Pipe was used in sanitary sewers on Federal projects. During the war, the Clay Pipe people couldn't keep up with the sudden, unprecedented demand, so standards were lowered to allow substitutes.

There's no Clay Pipe shortage now, and there's still no real substitute for Lifetime Vitrified Clay.

But outmoded Federal, State and Municipal regulations haven't been changed. They can mean many more framed engineers.

And taxpayers are forced to spend millions of dollars each year to replace sewer lines that should have been installed with lifetime pipe—Vitrified Clay Pipe with new cost-cutting factory-made compression joints—in the first place.

Name of Air Force base on request.

COMPRESSION SEALED VITRIFIED

CLAY IMPERVIOUS PIPE

THE STANDARD in SANITARY SEWERS

National Clay Pipe Manufacturers, Inc.

1028 Connecticut Ave., Washington, D. C.

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Ave., Washington, D. C.

Please send me full details on the new factory-made compression joints on Clay Pipe.

(name)

(company)

(street address)

(city and state) B-713 WS

New Literature

CONTINUED FROM PAGE 97A

tomer's specifications, including cutouts to fit around piping, stacks, machines, etc.

Engineering data presented in this brochure includes a Table of Safe Loads, typical designs and tables on weights and dimensions.—Rockwell-Standard Corp.

Circle No. 936 on Reader Service Card

Bed Expansion Gauges

Technical Bulletin No. 1005 illustrates and describes this manufacturer's Bed Expansion Gauges, an important addition to any filter plant. They measure accurately the amount of bed expansion in the filter at any time during the backwash operation. This information is needed since it is often impossible to see the level of the expanded filter media due to the turbid condition of the water.—Simplex Valve and Meter Co.

Circle No. 937 on Reader Service Card

Laying Concrete Pressure Pipe

A 16-page, pocket-size manual issued by this manufacturer lists the step-by-step procedure for laying concrete pressure pipe.

Contained in the book are instructions for digging the trench, checking the grade, handling the pipe, lubricating the joint rings, making the joint, checking the gasket, completing the joint and bedding the pipe. Also included are photographs which illustrate how each step is completed, detail drawings, deflection data, current tables of pipe sizes, and a full list of supplies and equipment that are needed for the job.—Price Brothers Co.

Circle No. 938 on Reader Service Card

Rotary Positive Blowers

A new 12-page bulletin issued by this manufacturer describes how Series 88 rotary positive displacement blowers provide constant metered quantities of gas or air, even against varying pressures.

The bulletin explains operating principles and tells how design permits mounting in several positions for maximum versatility. Other advantages such as low mechanical fric-

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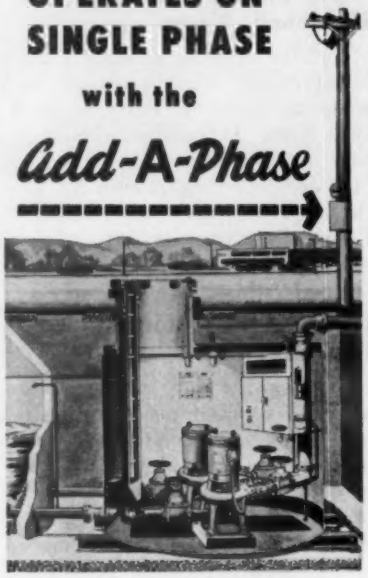
THREE PHASE SEWAGE PUMPING STATION..... OPERATES ON SINGLE PHASE with the Add-A-Phase

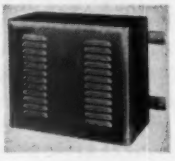


SMITH & LOVELESS
Division — Union Tank Car Company
LENEXA, KANSAS

Artist's installation drawing of a Smith & Loveless factory-built duplex sewage pumping station. The Smith & Loveless pump station is designed for capacities from 100 GPM to 4,500 GPM per pump with two or more pumps per station.

Add-A-Phase POWER CONVERTER

- Balances for Any Load
- 100% Rated Load
- High Power Factor
- Balanced Currents
- No Loss of Work Power



Write for Complete Information

ADD-A-PHASE Dept. WSW-9
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name Title

Company

Address

City Zone

State

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

tion and insurance against gas contamination by lubricants are also discussed. Two pages of photographs illustrate samples of custom package units designed for special requirements.—Sutorbilt Corp.

Circle No. 939 on Reader Service Card

Air Valve Catalog

Catalog R, a 26-page brochure, illustrates and describes this manufacturer's extensive line of air valves, identified under the trade mark of Crispin. These valves are designed and built to incorporate four important advantages: simplified construction; easy accessibility; maximum durability and efficient operation.

The following types are included in the catalog: Air and Vacuum Valves; Deep Well Air Valves; Pressure Air Valves; Model "P" Air Valves; Midget Air Valves; Combination Air Valves; Universal Air Valves; Dual Valves; Sewer Valves; Turbine Valves and Negative Pressure Air Valves.—Multiplex Mfg. Co.

Circle No. 940 on Reader Service Card

Sludge Furnaces

20-page Bulletin No. 238 illustrates and describes the Nichols Herreshoff Sludge Furnaces offered by this manufacturer.

Basically, the furnace consists of a circular steel shell surrounding a multiplicity of solid refractory hearths and a central rotating shaft to which rabble arms are attached. The furnaces are designed with various diameters and a varying number of hearths, usually between four and eleven. All of the solids removed from a sewage treatment process may be cleanly disposed of by complete reduction to ash in the furnace.—Nichols Engineering & Research Corp.

Circle No. 941 on Reader Service Card

Hypochlorination of Water

"The HTH Guide to Safe Water," a 12-page booklet issued by this manufacturer offers useful suggestions on the subject of water purification with HTH® in both granular and tablet form.

The discussion covers the following applications: General Water Purification; Algae Control (in the plant and at the reservoir); Treating Filters; Sanitizing New Mains (and other new construction); Cleaning Basins, Tanks, Flumes, etc.; Floods; Drought; and Miscellaneous Emergencies.—Olin Mathieson Chemical Corp.

Circle No. 942 on Reader Service Card

Liquid Chlorine Data Book

The seventh edition of the Pennsalt Liquid Chlorine data book has been simplified and tabbed by sections. Common physical properties, details on construction and unloading of various containers, materials of construction, and safety information have been described in concise, easy-to-use form.—Pennsalt Chemical Corp.

Circle No. 943 on Reader Service Card

Cast Iron Pressure Pipe

"Introducing Griffin Pipe," a 12-page brochure, illustrates and describes this manufacturer's line of cast iron pressure pipe, offered to be delivered on time because of the strategic location of the foundry at one of the country's great transportation hubs.

Manufactured in 20-ft. lengths, in the 4-inch to 12-inch diameter size range, there are fewer joints than with the conventional 16-ft. and 18-ft. lengths. A complete selection of pipe

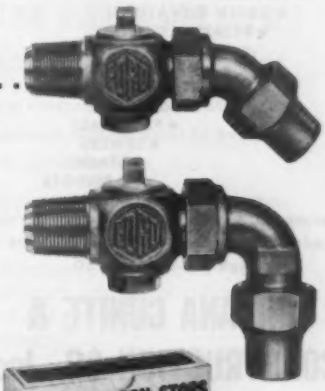
CONTINUED ON PAGE 100A

FORD
SERVICE
INSULATOR

This simple insulating unit, which includes a nylon dielectric bushing, can be attached to the outlet of a standard corporation stop. Connects to ordinary copper tubing with standard nut. Provides positive service insulation without gaskets or loose parts. Requires no special tools.

Always Specify
FORD CORPORATION STOPS..
made of finest water works brass.

Precision machined to accurate dimensions. Generous weight with good finish. Thick - substantial operating head. Ample wrench flat with sharp corners. Straight - Eighth - or Quarter bends available in ¾" and 1" sizes.



This attractive, strong Ford carton holds five ¾" or four 1" size Stops for easier handling, simpler storage and better protection from dirt and damage.

FORD for *better* water services

THE FORD METER BOX COMPANY, INC., Wabash, Indiana

Re-new your structures with GUNITE!

★ durability
★ economy
★ flexibility

- DAMS
- RESERVOIRS
- TUNNELS
- GRAIN ELEVATORS
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- FILTER PLANTS
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Gentlemen: Please have a representative contact me. I am interested in:
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.....
.....
NAME.....
STREET.....
CITY.....STATE.....

New Literature

CONTINUED FROM PAGE 99A

joints is available, including slip-on, mechanical joint, and bell and plain end. All pipe cement-lined to specification thickness.—Griffin Pipe Div., Griffin Wheel Co.

Circle No. 944 on Reader Service Card

Chemical Scale Remover

A brochure available from this manufacturer describes two products, Formula 1246 and 1286, developed to remove, effectively and economically, all types of scale deposits without dismantling equipment. Air conditioning systems can many times be cleaned while they are in operation by adding Formula 1286 directly to the cooling tower sump.—Industrial Chemicals, Inc.

Circle No. 945 on Reader Service Card

Total Oxidation Sewage Plant

Bulletin 6520-A, a 12-page brochure, illustrates and describes this manufacturer's Accelo-Biox® plant, an efficient low-cost sewage treatment plant designed especially to serve small communities or population-groups up to 3000.

It is offered in three types, providing an opportunity for an economical selection suited to each case. The complete plant includes the mechanism to provide aeration, recirculation and clarification, compressors, motors and electrical controls. A bar screen provided by the contractor should precede the plant. A Griductor® Comminutor is optional equipment.—Infilco Inc.

Circle No. 946 on Reader Service Card

Water Meters

Bulletin No. 60, a 20-page brochure, illustrates and describes this manufacturer's complete line of water meters in the following types: Frost-Bottom, recommended for areas

DIRECTOR OF PUBLIC WORKS WANTED

City of Platteville, Wisconsin; 7,000 population; 20 employees (exclusive of education and police departments); mayor and 8 councilmen. Must be registered civil engineer; experience necessary; salary open; can assume duties after Nov. 1, 1961. Send application, qualifications, experience record, and desired salary to L. C. Kindschi, City Clerk, Platteville, Wisconsin.

SPECIFY SUTORBILT 3200 SERIES BLOWERS FOR SEWAGE TREATMENT PLANTS

Rugged Sutorbilt rotary positive-pressure blowers reduce maintenance, cut replacement costs, and assure a high level of performance. They deliver 800 to 23,000 cfm at pressures from 2 to 12 psig. Available with timing gear diameters from 10" through 26" in horizontal designs. Many sizes also offered in vertical case arrangements. Ideal for aeration of grit chambers, channel aeration, pre-aeration flotation, flocculation, tank aeration, air lifts, gas recirculation.

Design Features

TWO-PIECE, impeller case strongly ribbed to prevent distortion

ONE-PIECE 4140 forged steel shaft, slip-fitted through impellers, attached at gear ends, allowing increased pressures and horsepower rating with complete safety

OVERSIZED ROLLER BEARINGS, in cartridges for easy removal

HELICAL ALLOY STEEL TIMING GEARS, piloted to shaft and bolted to timing hub

CLOSE-GRAIN CAST IRON IMPELLERS, precision bored to receive shaft

MACHINED SUB-BASES as standard equipment

LUBRICATION by force-feed pressure system

Write for detailed specifications on the versatile Sutorbilt Blowers. Dept. H.

Sales representatives in principal cities

4486
9-35

SUTORBILT IS WELL BUILT CORPORATION

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where freezing weather is prevalent; Split-Case, suitable for temperate climate areas; Solid-Case, designed for warm climate areas; Commercial Style, for multiple dwellings, small industry and department stores; and Heavy Volume, recommended for use wherever large flows are encountered and full range accuracy is desired.—Buffalo Meter Co., Inc.

Circle No. 947 on Reader Service Card

Volume, Density, and Porosity Measurements

An Application Data Sheet aimed at clearing up some of the ambiguity surrounding the term "density" has been published by this manufacturer.

For users of Beckman's Model 930 Air Comparison Pycnometer, the publication attempts to standardize terms by differentiating between substance density, particle density, apparent density, bulk density, surface porosity, total apparent porosity, and bulk porosity.

The Data Sheet also reports capabilities of the Pycnometer to produce accurate and rapid measurements of volume, density, and porosity. Measurement can be obtained with the instrument on powdery, granular, porous, and irregularly shaped solids.—Beckman Scientific and Process Instruments Division.

Circle No. 948 on Reader Service Card

Cement—Mortar Lining of Pipelines

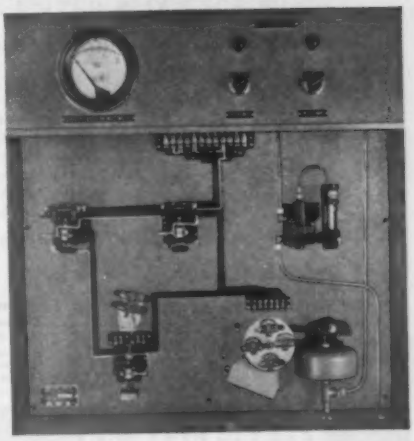
"The Centriline Process," a 20-page brochure, illustrates and describes this company's equipment and process for cement-mortar lining of pipes in place, from 4 in. to 144 in. diameter.

The process increases carrying capacity of the pipeline, stops leakage, and prevents interior corrosion and tuberculation.

CONTINUED ON PAGE 102A

POSITION OPEN TO REGISTERED ENGINEER; Design-Sanitary, in northern California. CE plus advanced study in sanitary, age to 50. Minimum of 8-10 years practicing experience in dealing with feasibility studies, consulting, engineering services, design and professional counsel to clients on water treatment, sewage and sewers. Also able to direct, layout work and supervise other employees. For a well established consultant—$10,000 to $12,000 per year. Contact Clair A. Hill & Associates, P.O. Box 558, Redding, Calif.

PRESSURE-OPERATED SUMP CONTROL



The RPS Rototrol is a pressure-operated sump control for starting and stopping pumps discharging out of a wet well. It is practical and dependable for either raw sewage or clear water—wherever accurate control of level is required.

The RPS is unaffected by changes in conductivity or build up in sludge. Has no moving parts in the wet well. Can be located anywhere. Requires only pressure connection between control and wet well. Operates from plant air or separate air compressor.

For full details, write for Bulletin RPS.

FLOAT CONTROLS—Healy-Ruff also makes a complete line of float-operated controls. Rototrol 940 permits each pump, up to 10, to have several starting and stopping positions. RF2 controls up to 8 pumps in sequence. Type 151 provides single pump control. Automatic alternator or transfer plugs available optionally.

Write for descriptive literature.

HEALY-RUFF COMPANY

783 Hampden Avenue • St. Paul 14, Minn.

First in dependable controls for waterworks and sewage—since 1929.

Remote supervisory controls • Complete system controls. Elevated tank controls • Sump controls • Hydropneumatic tank controls • Float controls • Alternators • Alarm silencers • Protective devices

Magnified activated silica sol floc.

*Patent No. 2,567,285, license royalty free

WANT

CLARIFICATION RESULTS LIKE THESE?

...try Activated Silica Sol

- **Reduced alum consumption saves $30.00 per day**
- **Filter runs extended 50%, to about 36 hours**
- **Best water we have ever seen**

This report comes from a water company treating 30 million gallons daily. Activated silica sol was needed to solve cold water coagulating problems. Advantages prompted year-round application where they rely on "N" silicate (only ½ ppm SiO_2) fed continuously by way of the N-Sol-C Process.*

Send for Bulletin, "Treatment Of Raw And Waste Waters."

PHILADELPHIA QUARTZ COMPANY

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Associates: Philadelphia Quartz Co. of Calif., Berkeley & Los Angeles, Calif.; Tacoma, Wash.; National Silicates Limited, Toronto & Valleyfield, Canada

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No matter what your storage problem, a prestressed concrete tank offers many immediate and long term advantages. Minimum maintenance, longest service life, lowest overall cost, 75% of construction cost is spent locally. Modern in engineering and design, proven in service, lowest in cost...prestressed concrete should be considered in any tank planning.

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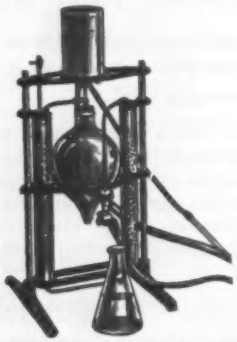
MERRICK IRON WORKS P.O. Box 3007 25450 Clawiter Rd. Hayward 2, Calif.

PRESTRESSED CONCRETE

ENSLOW

STABILITY INDICATOR



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.
P. O. Box 2V Richmond 5, Va.

YOU KNOW IT'S PURE

People everywhere depend on the purity of water processed by Roberts Filter equipment.

For over 60 years, Roberts Filter Manufacturing Company has supplied water purifying equipment vital to the needs of municipalities and industries throughout the Western Hemisphere.

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MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MANUFACTURING COMPANY
607 COLUMBIA AVENUE, DARBY, PA.

New Literature

CONTINUED FROM PAGE 101A

This company operates on a "turnkey" basis, handling excavation, cleaning, lining, and all related work. There is no division of responsibility, and no need for the municipality to furnish crews, equipment or supervision.—Centriline Corp.

Circle No. 949 on Reader Service Card

Elevated Water Tanks

16-page brochure illustrates and describes this manufacturer's Modern elevated water tanks identified as the "Watersphere" and the "Waterspheroid." The first one is built in capacities from 25,000 to 250,000 gallons; the second one, in capacities from 200,000 to 500,000 gallons.

The Watersphere is a spherical tank supported on a single cylindrical column. The Waterspheroid has a spheroidal-shaped tank. The two types are identical in all other aspects. Both the tank and column are constructed of steel plates with butt-welded joints.—Chicago Bridge & Iron Co.

Circle No. 950 on Reader Service Card

Municipal Engines

4-page brochure illustrates and describes this manufacturer's line of Climax® Municipal Engines designed to provide low cost power for sewage and water treatment plants.

These rugged engines give quick acceleration, withstand overloading, and perform longer with less maintenance. The rigid, one-piece alloy iron crankcase is heavily ribbed for greater strength.—Climax Engine Mfg. Co., Div. of Waukesha Motor Co.

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Pipe Cutter

Catalog and price list No. 42 illustrates and describes this manufacturer's heavy duty Pipe Cutter.

The tool is an all-purpose cutter with interchangeable cutter wheels for all types of pipe: cast iron, steel, as well as vitreous clay pipe. Requiring only space enough to move the tool in a small part of a circle, it is well suited for use in trenches or other tight places.—Ellis & Ford Mfg. Co.

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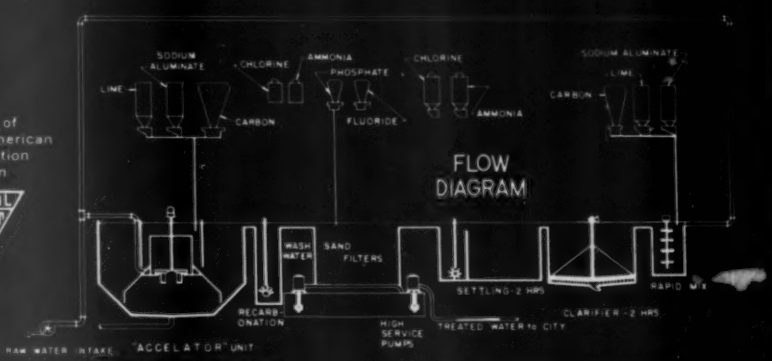

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